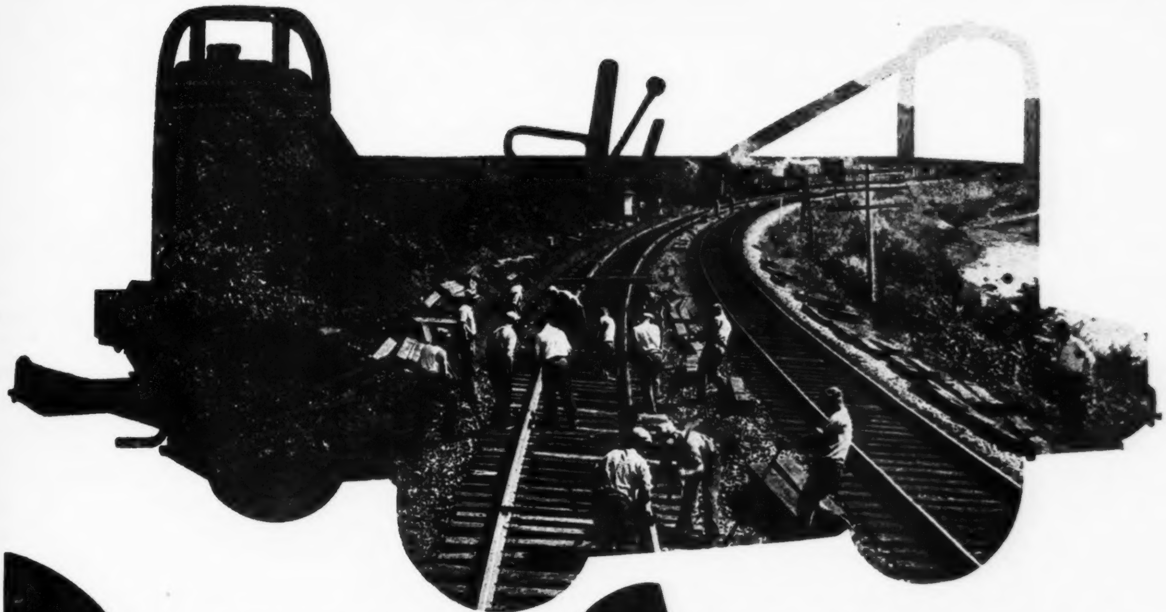
Railway Engineering and Maintenance

June, 1935



POWER and STAMINA

for Gang Work

POWER, stamina, capacity and lightweight construction place this Fairmont A5(Series B) in the front rank as a gang car that meets every requirement; from the hauling of full gangs with tools and materials on trailers to the jobs of heavy maintenance.

Despite the rugged strength of its structural steel frame and the roomy space of its white oak body, this gang car has been designed by Fairmont for easy handling and weighs only 1,700 lbs.

And it has power to match its durability—a 4-cylinder 33 h.p. industrial type engine which, in conjunction with a four-speed transmission, furnishes the surplus power that makes good time . . . even when loads are heavy and grades are steep . . . and does a thorough job on heavy duty service usually assigned to much heavier cars.

The Fairmont A5(Series B) offers an outstanding combination of features that lowers operating costs, broadens the scope of service and extends the life of the car used in this gruelling classification of railroad work.

FAIRMONT RAILWAY MOTORS, INC., Fairmont, Minn.

Inspection Motor Cars . . Section Motor Cars . . B & B and Extra Gang Cars . . Gas-Electric Ditchers . . Shapers . . Ballast Cleaners . . Ballast Drainage Cars . . Mowers . . Weed Burners . . . . .

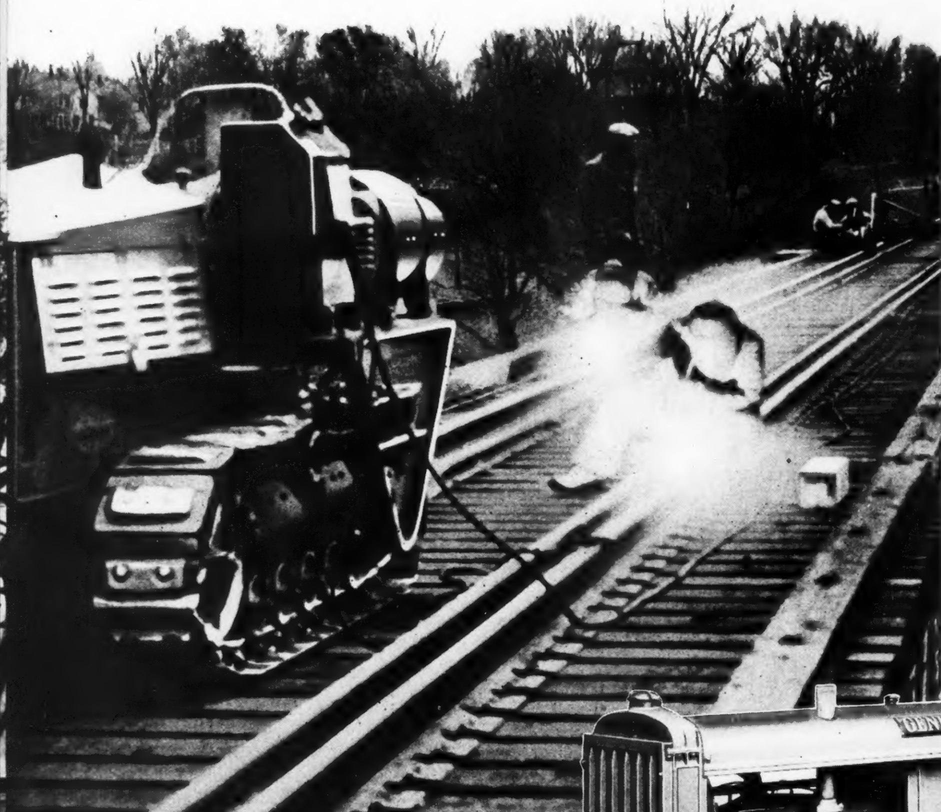
Performance ON THE JOB COUNTS

Fairmont

Extinguisher Cars . . Power Cars; Air, Electric, Paint Spray, Tie Tamping . . . Rail Coaches . . . Motor Car Engines . . Push Cars and Trailers . . Roller Axle Bearings . . Wheels and Axles . . . .

Published monthly by Simmons-Boardman Publishing Company, 105 W. Adams St., Chicago, Ill. Subscription price, United States and Possessions, $2.00; Canada, $2.50; Foreign, $3.00. Single copies 35 cents. Entered as second-class matter January 20, 1933, at the postoffice at Chicago, Illinois, under the act of March 3, 1879, with additional entry at Mt. Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.

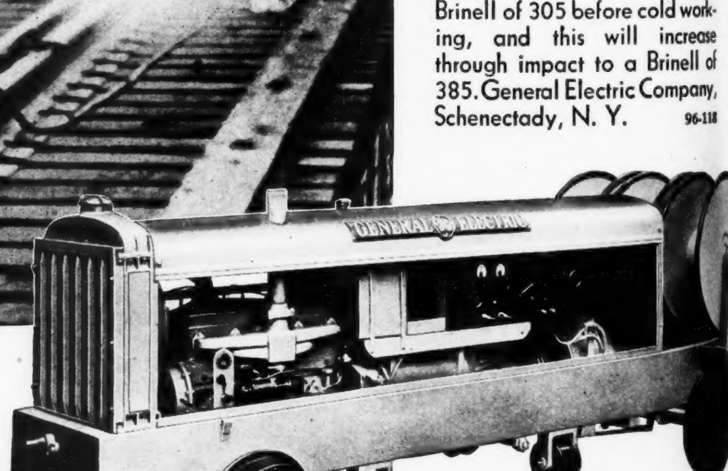
That electric welder saves us money at every rail joint!



MANY railroads have found that by rebuilding battered rail ends, they can extend the life of the rail five years or more, under normal traffic conditions. They have also found that electric welding will reduce the cost of such rebuilding under other methods by 50 per cent.

General Electric can furnish you portable railroad-type welding equipments, embodying the most advanced proven features. These equipments are entirely self-contained and self-powered. They can provide energy for one or two welding circuits, and, in addition, can be arranged for supplying power for grinding, slotting, and other auxiliary operations.

You will also find the G-E Type W-90 electrode ideal for rebuilding rail ends. On a rail having a Brinell hardness of 252, the W-90 will deposit a Brinell of 305 before cold working, and this will increase through impact to a Brinell of 385. General Electric Company, Schenectady, N. Y. 96-118



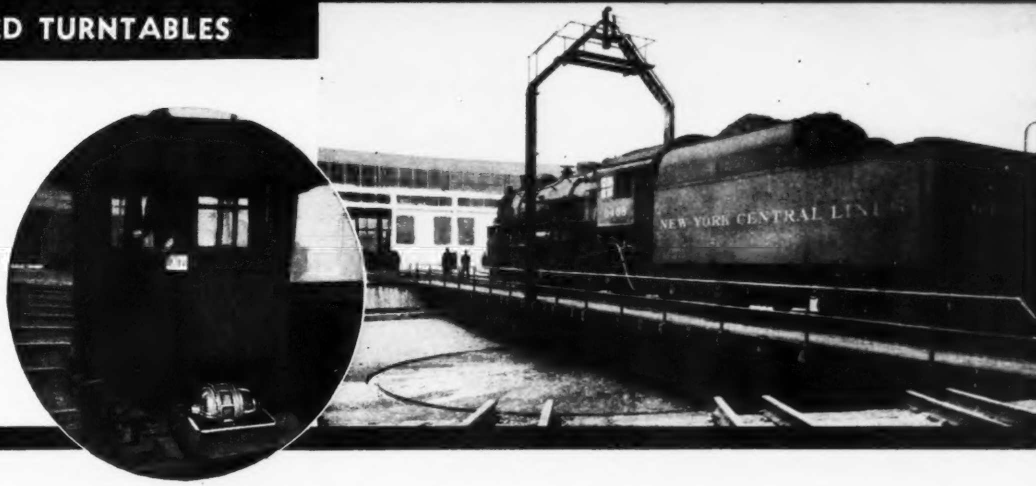
G-E TYPE WD-33 PORTABLE RAILROAD WELDING EQUIPMENT

One unit of the complete G-E line

GENERAL

ELECTRIFIED TURNTABLES

Electrically powered turntables are time savers. Their high-speed operation helps to keep locomotives at work. Turntables equipped with G-E motors and control are highly efficient, requiring minimum power and attention. And they are easy to control. G-E motors for this service are noted for long life and reliable performance.

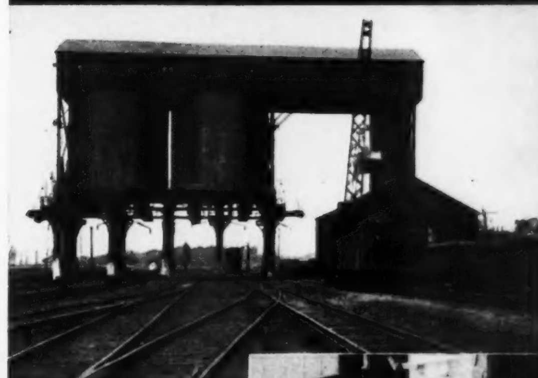


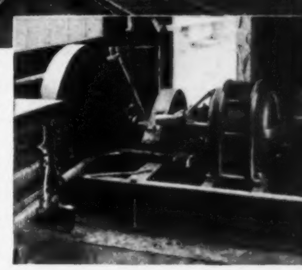
Here are more ways to save electrically all along your road

ELECTRIFIED LIFT BRIDGES

Wherever rails cross rivers, you can depend on G-E electric equipment to raise and lower the span swiftly, safely, and economically. When a bridge project comes up, consult G-E bridge-equipment specialists. They have the experience to recommend the *right* electric equipment. Shown above is the newest G-E equipped bridge, part of the Pennsylvania's Newark Station development.

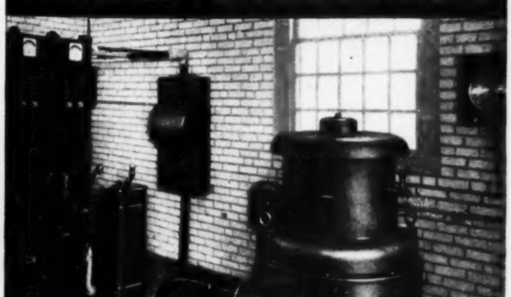
ELECTRIFIED COALING STATIONS





Modern electrically operated coaling stations help to relieve congestions at terminals by minimizing coaling time. In this New York Central coaling station, G-E motors and control (*inset*) move the cars as they are emptied, in addition to driving conveyors.

ELECTRIFIED PUMPING STATIONS



Many railroads have saved money by electrifying their water service. As a result of the trend toward longer engine runs and larger-capacity tender tanks, fewer water stops are required today than were necessary when most of the existing stations were built. Consequently, it is generally possible to reduce the number of pumping stations required, by relocating them and equipping them for electric operation.

THESE ELECTRIFIED TOOLS Speed Maintenance-of-way Work

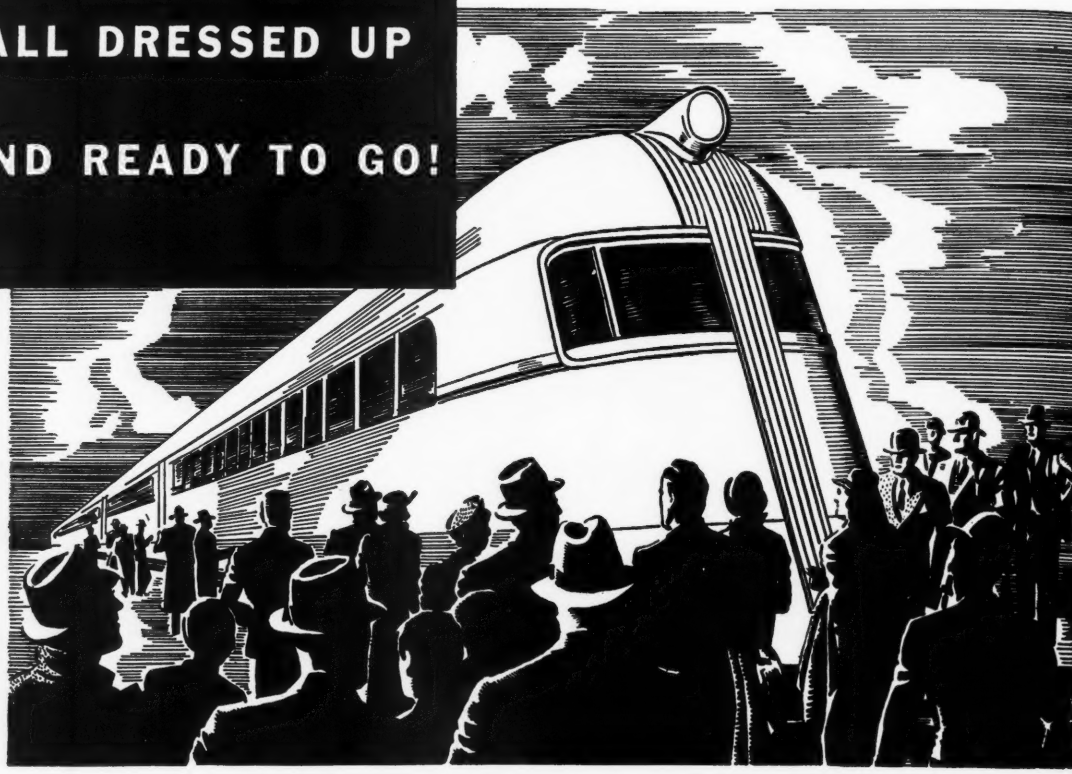
- Electric tie-tampers
- Electric nut tighteners
- Electric floodlights
- Electric drills
- Electric instruments
- Electric ballast cleaners

Electric grinders and slotters used in rebuilding battered rail ends

Electric arc-welding equipment and electrodes for strengthening steel bridges, rebuilding rail ends, and rebuilding frogs and crossings

ELECTRIC

ALL DRESSED UP AND READY TO GO!



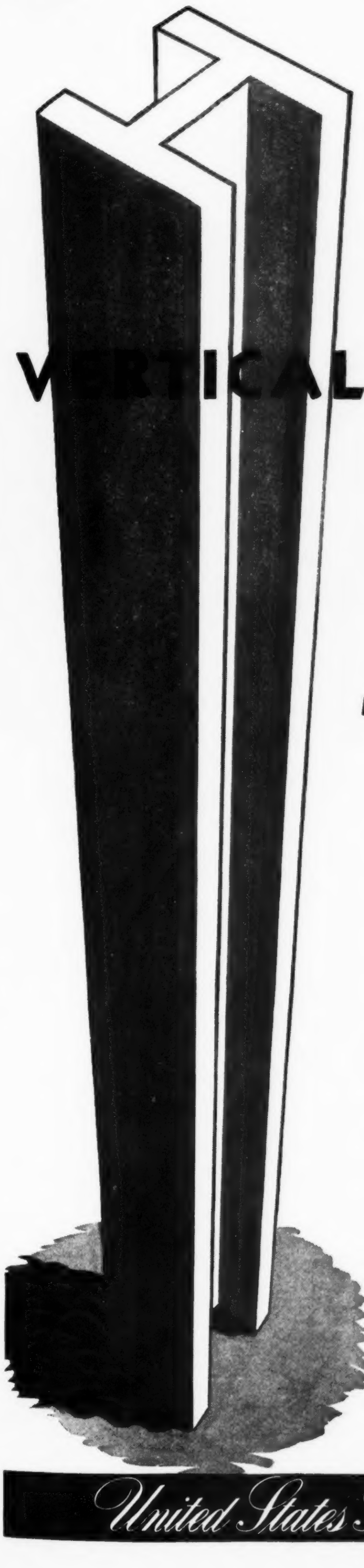
The high-speed, stream-lined train has arrived . . . ready to go places and do things for rail transportation. Is *your* track ready? Will it permit this 100-mile-an-hour train to demonstrate its full possibilities, giving proper consideration, of course, to the safety and comfort of passengers? Have you counted the cost to maintain the high standards of gauge, line and surface that are absolutely necessary? • GEO is the solution. It was designed for speeds of 100 miles an hour or better. It has demonstrated its safety, its smooth-riding qualities, its accurate alignment and its low maintenance costs under high-speed traffic. You who are considering modern trains should include this modern track in your plans. We will be glad to furnish complete details.

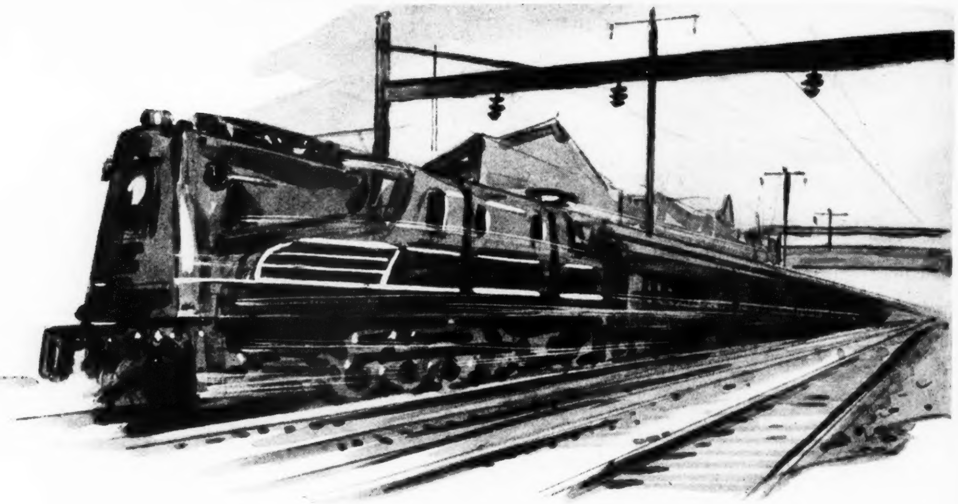
CARNEGIE STEEL COMPANY
PITTSBURGH, PA.

THE LORAIN STEEL COMPANY
JOHNSTOWN, PA.

327

United States Steel Corporation Subsidiaries



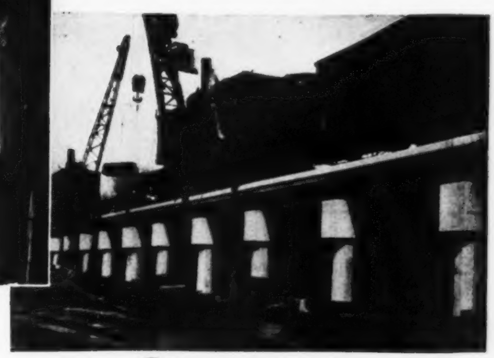


from this 43 minutes *to this*

1 *10:37 A. M.* The small crane removes the old deck. Rails remain connected.

2 Big crane sets the 18-ft. half-slabs.

4 *11:20 A. M.* Only 43 minutes have elapsed from the time the removal of the deck began until track is blocked up on the slabs and the line is again ready for traffic.



3 Small crane is ready with track ties and blocks as the last slab is set.

using PRECAST CONCRETE TRESTLE DECK SLABS

TALK about ease and speed . . . it took only 43 minutes to remove two old deck panels, set two 18-ft. panels of concrete deck (4 precast half-slabs), and put track back in service.

Just normal operation to this crew, which has placed as many as 6 panels in 8 hours on this single-track line, with only $1\frac{1}{2}$ hours maximum period of free time.

Much attention has been given to the fact that concrete trestles are fireproof, slow to depreciate and economical to maintain. To these familiar advantages add this one: concrete piles can be driven and deck slabs set with no more interference to traffic —and perhaps less—than in building any other type of trestle.

As to *first* cost—a 3-pile concrete trestle, erected with proper equipment, crew and supervision, costs little more than less enduring construction. And where replacement must occur under adverse traffic conditions, concrete may easily be cheaper.

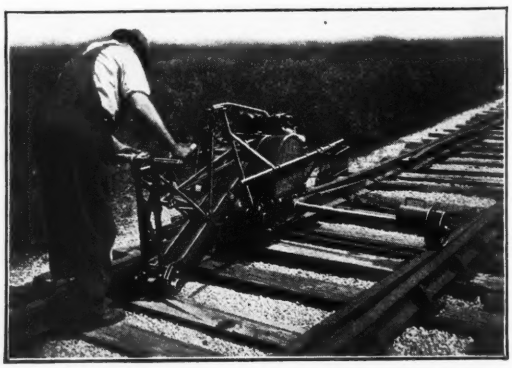
Write for Concrete Information Sheet RB-1, *"Large Concrete Piles."*

PORTLAND CEMENT ASSOCIATION

Room 476, 33 West Grand Avenue, Chicago, Illinois

For Those Rail Reconditioning and Relaying Jobs

In addition to this Rail Grinder for reconditioning welded rail, Nordberg also builds the general purpose Utility Grinder for slotting, surfacing, switch maintenance and similar jobs.



A Nordberg Track Wrench should be at the head and rear of your relaying gang. Also can be used the year round for the maintenance of joints.

If you have a rail program this year, laying new rail or reconditioning rail in service, these machines are indispensable if you are giving serious consideration to quality of work done and what you can accomplish with a given appropriation. You will make no mistake if you join with other progressive maintenance officials, who have standardized on Nordberg Power Tools for track work.

NORDBERG MFG. CO.
MILWAUKEE, WIS.

Pulling 35 to 40 spikes a minute makes the Nordberg Spike Puller a necessity for rapid progress wherever rail is removed.

Because of the perfect tie seats produced by Nordberg Adzing Machines, machine adzed ties are now required by many of the leading roads.

NORDBERG MAINTENANCE MACHINERY

No. 78 of a series

Railway Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING COMPANY

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: For 40 Years a Reader

May 30, 1935

Dear Reader:

In our last issue I told you that we had found our oldest reader —William Woolsey, section foreman of the Illinois Central at Ridott, Ill., who has subscribed for Railway Engineering and Maintenance and its predecessor publications continuously since 1904. It now appears that I was wrong, for I have since received a letter from L. C. Ayers, general superintendent of the Norfolk & Western at Roanoke, Va., who challenges my finding and presents proof that he is our oldest reader.

"Railway Engineering and Maintenance," Mr. Ayers writes, "is a 'husky' descendant of that old publication, Roadmaster and Foreman, to which I first subscribed in 1895 when I was a section foreman. Since that time I have been a consistent reader of it and its succeeding publications. I have, therefore, nine years' seniority over William Woolsey whose letter you quoted in your May issue."

We are delighted with the interest which our search for our oldest reader has aroused. We are proud of the fact that busy railway men like Mr. Ayers have found sufficient information of interest and help to them to cause them to subscribe to our publication for 40 years. This is a long time. I am wondering, however, if there might be some among our more than 7,000 readers whose subscriptions antedate that of Mr. Ayers.

It may interest those of you who have entered our circle of readers in recent years to know something of the early history of Railway Engineering and Maintenance. Its earliest antecedent is the Roadmaster and Foreman, which was established in 1884 and was continued as a separate publication until May, 1911, when it was consolidated with a magazine called Railway Engineering and Maintenance of Way, which had been established in 1905.

In May, 1911, the Railway Age initiated a maintenance of way section of 24 pages devoted to maintenance of way problems, and published in the third weekly issue of each month. In May, 1916, this section had developed to the point where it was set up as a separate magazine under the name of the Railway Maintenance Engineer. Coincident with this change, the magazine, Railway Engineering and Maintenance of Way, was consolidated with it. The Railway Maintenance Engineer has been published under the same management continuously since 1916, the name being changed to Railway Engineering and Maintenance in January, 1923.

Yours sincerely,

Elmer T. Howson

Editor

ETH:EW

and Now

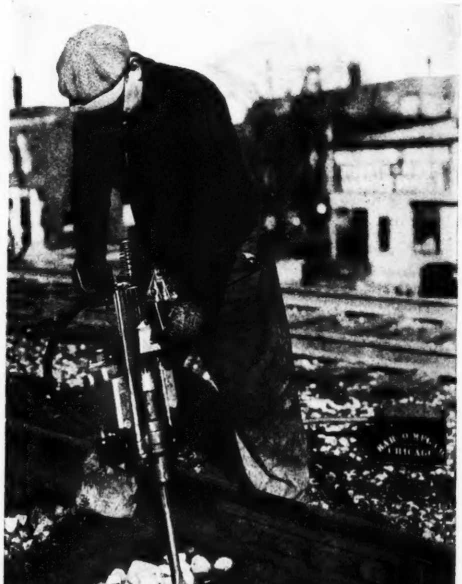
THE BARCO

ONE MAN TIE TAMPER

The Barco Unit Tytamper is a portable tytamper, requiring only one man to handle. The operation is through a single cylinder air-cooled two cycle gasoline engine within the hammer, using low test gasoline.

The Barco Unit Tytampers may be used singly or in units of 2, 4, 8, 12, 20 or more without requiring any extra or special equipment of any kind, or may be used individually for spot tamping and maintenance.

The Barco Unit Tytamper is simple in design and rugged in construction and may be taken apart and re-assembled very quickly by the ordinary workman and does not require highpriced experts.



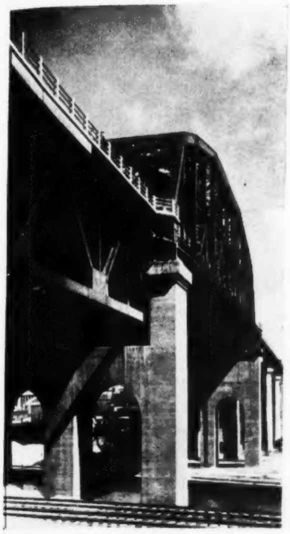
The Barco Unit Tytamper is comparable to the air Tie Tamper in number of blows per minute and power.

The cost of operation and maintenance is extremely low, usually running around fifteen cents per hour or less.

The Barco Unit Tytamper is recommended for tamping, where large gangs are used, or for spot tamping on line of road, or around terminals where train movements are heavy.

BARCO MANUFACTURING COMPANY

1801-1815 WINNEMAC AVENUE CHICAGO, ILLINOIS



Published on the last Thursday preceding the month of issue by the

SIMMONS-BOARDMAN PUBLISHING COMPANY

105 West Adams Street, Chicago

NEW YORK
30 Church Street

CLEVELAND
Terminal Tower

WASHINGTON, D. C.
932 National Press Bldg.

SAN FRANCISCO
55 New Montgomery Street

Subscription price in the United States and Possessions, 1 year, $2.00, 2 years, $3.00; Canada, including duty, 1 year, $2.50, 2 years, $4.00; foreign countries, 1 year, $3.00, 2 years, $5.00. Single copies, 35 cents each.

Member of the Associated Business Papers (A. B. P.) and of the Audit Bureau of Circulations (A. B. C.)

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

June, 1935

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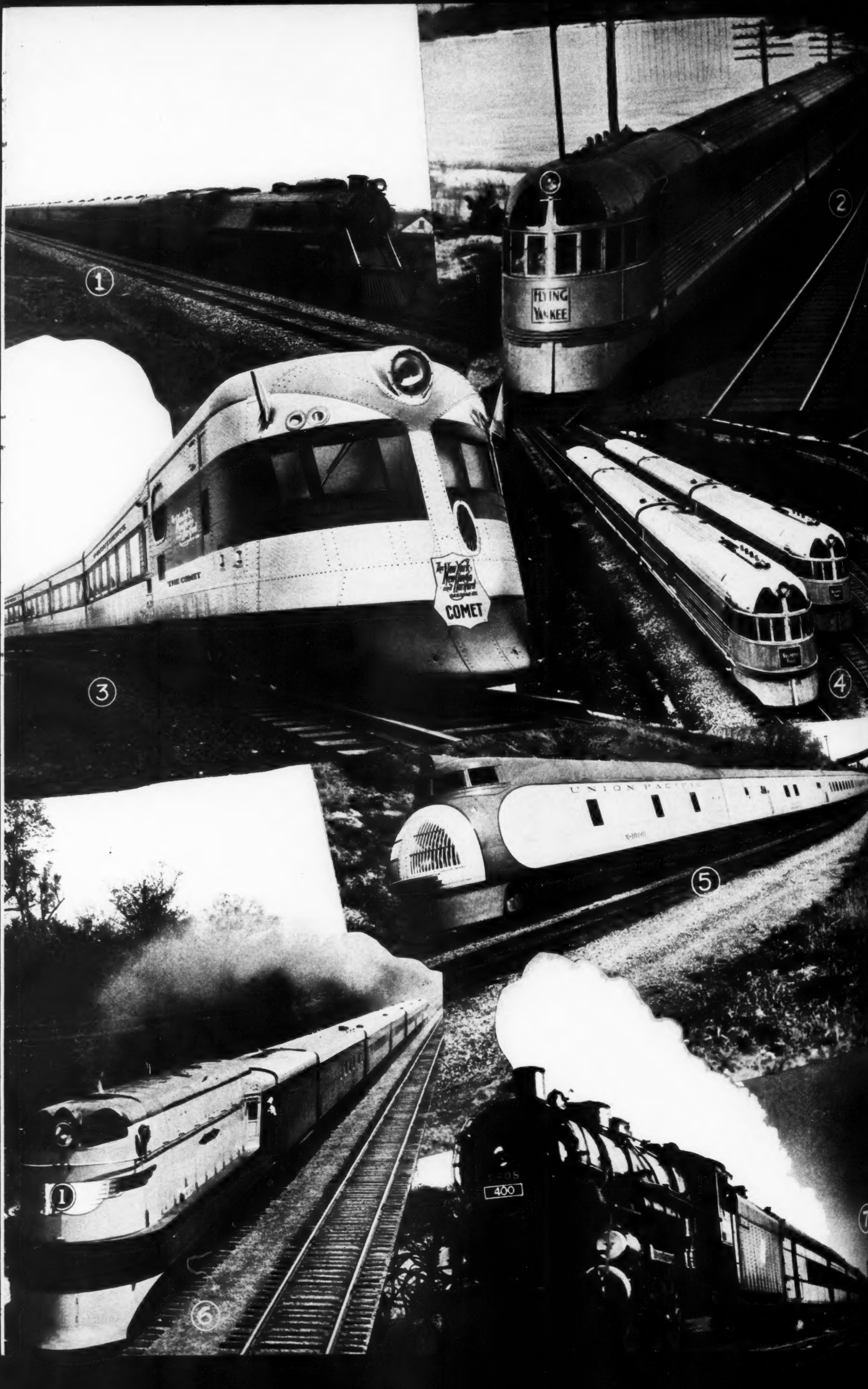

FLYING YANKEE
THE COMET
COMET
UNION PACIFIC
400

Railway Engineering and Maintenance

Romance

There Is Much of it in Railroading

THERE was a time when every normal boy aspired at some period in his youth to be a locomotive engineman. The man in the cab was his hero and he looked forward to the day when he might himself handle a throttle. There was something about its power and its potential speed that fired his imagination. Nor was this interest in railways confined to the locomotive, for it was aroused as well by such outstanding structures as the Eads bridge over the Mississippi river at St. Louis and the trestle across Great Salt Lake, by the tunnels through the mountains and by such examples of the locator's skill as the Horse Shoe curve in Pennsylvania. All of these possessed an interest that was well nigh universal.

New Trains

Of late years, newer agencies of transportation, notably the airplane, have threatened to dislodge the railways in this appeal. However, the fact that this interest in the railways has not disappeared but has merely been dormant for a time has been demonstrated in a striking manner during the last year. As one new train after another has been displayed about the country, it has been the universal experience that it has been thronged with people eager to see the improvements. Nor has this interest been confined to the first of these trains, for as later trains have been introduced, they have commanded the same interest.

An Asset Uncovered

Through these trains, the railways have rediscovered an asset which they have long possessed but the value of which they have failed to appreciate adequately. All too long they have neglected to dramatize the many improvements which they have been making until a large part of the public has gained the impression that the railways have been standing still at a time when they were actually making the greatest developments in their history.

This unfortunate impression has arisen from lack of knowledge of what the railways were really doing. The railways are now awakening to this situation. The western railways in particular are now taking steps to correct it. First among the measures which they have instituted is the initiation of an extensive advertising campaign in some 444 newspapers and magazines and 29 major radio stations throughout the country to acquaint the public with the newer features of rail travel, lower fares, air conditioning, faster schedules, etc., as well as those other advantages such as unparalleled safety and dependability of schedules.

Railroad Week

Another feature of this program of the western railways is Railroad Week—from June 10 to 15—during which railway employees in every community will be enlisted in a campaign to acquaint the public with the railways of today and to make people "railroad-minded." This program offers large opportunities for service to railway employees of all ranks and of all departments. It offers opportunity especially to maintenance employees because they are resident in every community that the railways serve and with the station agent are, in many cases, the only local representatives.

A feature of this week's program in many communities will be receptions in which the public will be invited to visit roundhouses, shops, freight houses and classification yards and where they will be shown the diversity and magnitude of railway operations and given an appreciation of the skill and efficiency with which these operations are conducted. At points where such facilities are not available for display, employees can tell by word of mouth of the achievements of their roads in ways that will stimulate interest. Furthermore, the operation of such equipment as a mechanical tie tamper or of even more simple tools in the hands of a resourceful foreman or supervisor can be made interesting to the residents of many rural communities.

The Employee's Part

Railway employees can do much to extend the influence of this campaign by seeing that all of those with whom they come in contact are informed about the outstanding achievements of the railways in the last few years and especially regarding the innovations which they have instituted during the last year to reduce the cost and increase the safety and comfort of travel. Employees can do much to convince those in their communities not only regarding the indispensability of railroad service but also concerning the manner in which it is not only keeping pace with, but is actually leading industry at large to new levels of efficiency and service.

The plans for a Railroad Week offer great possibilities in village and city alike—all with the objective of

reselling the public to the progressiveness of the railways by showing them the developments that the roads have made of late years. When this is done, a great step will have been taken in making the public railroad-minded, a step that is necessary to the recovery of much of the traffic that is now going to other transportation agencies. The success of the plan as a whole will depend largely on the extent that each employee makes it his job to see that it succeeds within the radius of his contacts.

Laying Rail

Modern Methods Demonstrate Efficiency

AS FAR back as memory goes there has been competition between roads, and between rail gangs on individual roads, to establish records for the amount of rail laid in a day, and for sustained laying over longer periods. Even when allowance is made for the extensive preparations that sometimes preceded the actual laying of the rail, some remarkable records have been established. On the other hand, records have seldom been available from which the overall cost of laying the rail in this manner can be determined. Obviously, the cost of the preparatory work is a part of the total cost of laying the rail.

One of the serious objections which has been raised to the practice of laying for record, is that the rail is seldom properly cared for, since attention is concentrated on progress rather than on quality of work. If, therefore, the rail is damaged for lack of proper care, or if it requires intensive maintenance later to prevent damage, little advantage is gained from laying a few hundred feet or a few miles more rail than one's competitor. The loss from damage or the cost of preventing damage is truly a part of the cost of laying the rail. Whether it gets into the accounts as such is not pertinent.

In contrast, modern rail gangs seldom seek to establish new records. The quality of the work they leave behind them is of more importance in the mind of the average roadmaster than the maximum amount of rail that he can lay in a day, although total production is by no means ignored. In a fully mechanized and well-organized rail gang, everything revolves around the rail crane, and all preceding and following operations are synchronized with the progress it can make. For this reason, every part of the work can be given proper supervision. The application of the joints, the bolting, the gaging and the spiking can all be done without undue haste and with assurance that the rail will be properly seated and that nothing will be overlooked. Any loose ties are tightened and anti-creepers applied, so that when the last unit in the gang passes, the track is ready for full speed, except for a short interval of low speed to insure that the tie plates will settle vertically.

To one who remembers the confusion and regrettably poor work that has sometimes attended efforts to make a record, the clock-like regularity of the progress of the rail gang of today and the condition in which it leaves the rail as it passes, stand in strong contrast to the former practice. Furthermore, all of the costs of laying the rail are open to inspection, since there are no hidden costs from damaged rail or in later maintenance.

Curves

Higher Speeds Create New Problems

THE curve is coming into its own as an object of attention by maintenance men. It has, of course, long been recognized as a major problem in preparation of smooth-riding track. However, with the initiation of passenger service at speeds markedly higher than those which have prevailed in the past, it is now demanding and receiving greater consideration than ever before.

The railways are engaged in a highly competitive business today. Agencies on the highways, on the waterways and in the air are all endeavoring to attract traffic from the rails. The principal advantage claimed for the planes is speed. Whether we like it or not, we must face the fact that the public is now speed-minded and that we are in an era of higher speeds in transportation. The new trains which the railways are announcing almost daily are their answer to this demand.

These trains are of very direct interest to engineering and maintenance men of all ranks. In the first place, every such man has a very direct interest in the future success of the railways, for he is dependent on them for his livelihood. He has seen passenger traffic drop year after year until it is now only one-quarter as large as it was 15 years ago. He knows that this loss in traffic has reduced the income of the railways two and a half million dollars a day. He appreciates the fact that no industry can stand such a drain indefinitely.

Now he sees these new trains being introduced by one road after another in an effort to attract public favor. It is to his own selfish interest to contribute in every possible way to the success of these trains. And he can contribute very directly. Just as any train service can be marred by indifferent handling by an engineman, no train will ride better than its track. Good track is the very foundation for good service. Furthermore, track that rides well at speeds of 50 miles per hour may ride very poorly at 75-80 miles. It is here that the new trains place an added burden on the maintenance man—at a time when revenues are at a low ebb and expenditures cannot be increased at will.

These high-speed trains, first of all, necessitate a refinement in track maintenance that, on most roads, has not heretofore been warranted. They require more prompt attention to minor defects in line and surface, on tangent as well as curve, than has been deemed necessary heretofore. In this respect they require a change in point of view on the part of foreman and supervisor alike.

With respect to curves, the higher speeds now coming into vogue require greater care in determining the amount of superelevation of the outer rail to provide comfortable riding. Equally if not more important, they require a uniformity of elevation not heretofore prevailing in order not only to avoid possibility of derailment but also to avoid irregularity of riding that will give the lay passenger a sense of insecurity at high speeds.

Second only to curve elevation in importance to curve riding is a proper approach to the curve, both as to the length of the spiral and as to its elevation, in order that the transition from tangent to curve and vice versa may

not be noticeable. Here practice has long differed among the railways. Not a few well-maintained roads have contended that a spiral on a curve of less than two degrees was an unwarranted refinement, although extending the superelevation out on the tangent. Other roads have used relatively short spirals and have carried the superelevation back somewhat further. Still others have made their spirals and superelevation coincident. With the increased speeds now coming into vogue, this divergence in practice becomes increasingly important. Both theoretically and practically, it would appear that the third practice has much to commend it.

Essential as it is to bring the curves up to a high standard of line and surface preliminary to the inauguration of high-speed service, it is equally important that it be maintained in that condition from day to day. Not only are these high speeds more exacting in their demands on the curves, but they are likewise more destructive of them. This gives added value to the amounts which a road is warranted in spending for better and stronger materials that will offer greater resistance to this added wear and tear. It increases the importance also of the use of those units of mechanical equipment which either lower the cost of doing that work which must be done or give it added permanence. In other words, the increased destruction that must be overcome increases the investment that a road is warranted in making, in the long run, to make good this destruction.

In brief, the railways are entering an era of higher speeds for passenger trains as a means of recovering traffic. These speeds can be maintained only to the extent that track maintenance keeps pace. In this one step, the traffic and operating departments have taken advantage of the reserve strength that the maintenance department has been building into its roadway during the last 15 years. It is essential that this strength be maintained in order that the railways may deliver what they have set out to do. These new trains offer much of promise to the railways. They constitute a challenge to the maintenance of way department.

Leadership

How Shall It Be Exercised?

OTHER conditions being equal, that man is selected for advancement who excels in his present position. This statement is trite in-so-far as relates to the man who is striving for promotion, but it has some potent implications with respect to the new job for the man who has just been promoted that are not so often discussed.

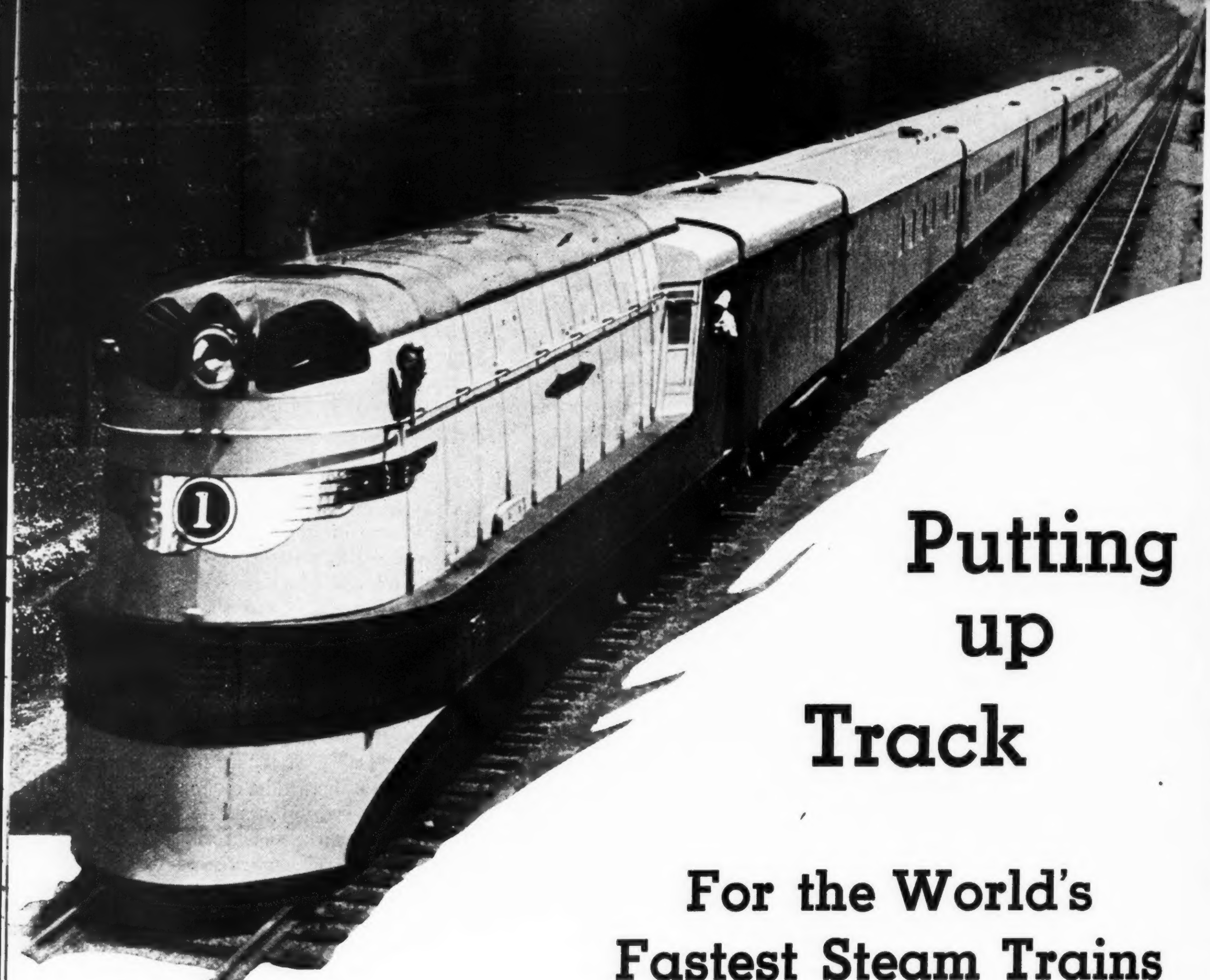
The foreman who has been advanced to supervisor becomes responsible for the work of other foremen who are engaged in the same kind of work in which he himself had been employed for some years. What is to be his attitude toward them and their manner of handling their work? A bridge foreman was advanced to bridge supervisor following an enviable record for the performance of his gang on several pile driving jobs, but after a few weeks in his new position he asked to be relieved and that he be returned to his old gang. On being asked the reason, he said that he could get better work out of a gang himself than he could get done through the foremen of the gangs under his direction. After some kindly advice and encouragement from his superior officer, he agreed to carry on, and developed into an efficient supervisory officer.

This business of expecting others to handle work that he feels he can do better himself is something that confronts every new supervisor who has had long experience as a foreman. Some make the mistake of attempting to function as a sort of super-foreman of each gang, giving the most explicit directions and insisting that the nominal leader of the gang shall immediately give up his own methods and adopt those of the new supervisor. Obviously, the supervisor who leaves his foremen entirely to their own resources is not supervising, and such a policy will not result in any improvement in quality of work or output of gangs. But the supervisor who attempts to run the whole job and who does not encourage his foremen to think for themselves will soon find that he alone is doing all the thinking that is being done on maintenance matters.

The supervisory officer on maintenance work is expected to introduce his ideas and methods, and to follow up the work closely enough so that he can be certain of the rate of progress, the quality of the output and the safety of every step taken, but he will be more successful in the end if he exercises supervision in such a way as to encourage rather than dampen the resourcefulness and initiative of the foreman under his supervision.

In the start, the new job resolves itself largely into a matter of studying the foremen—to learn their weaknesses and elements of strength to the end of finding out how well they can be relied upon. In other words, the new supervisor must determine just as soon as possible what he can expect of each of his foremen and to what extent he may depend on them in both routine work and in emergencies. Having reached this stage, he is in a position to plan a campaign for the improvement of performance. Just how this is to be done is a matter that he must decide for himself in dealing with each individual foreman. A man is chosen for the position of supervisor because he has evidenced leadership, an attribute that is not acquired from books.

Water station on the St. Louis-San Francisco at Pickensville, Ala.



Putting up Track

For the World's Fastest Steam Trains

WHEN the Chicago, Milwaukee, St. Paul & Pacific placed the world's fastest long-distance steam-operated trains in operation on May 29, it brought to completion a period of preparation in which the roadway department had a large part. These trains operate between Chicago and the Twin Cities on a schedule of 6½ hr., or 390 min., for the 410 miles to St. Paul, Minn. They consist of one diner, three coaches and two parlor cars which, although streamlined and of light-weight construction, are otherwise of conventional design, except for the "beaver tail" at the rear. They are drawn by the first streamlined locomotives to be built specifically for high-speed service, which are designed to attain maximum speeds of 120 miles an hour and to maintain speeds of 100 miles an hour in regular service. Because of the time lost in making stops and in reducing speed through yards, at junction points, over draw bridges and at other restricted points, sustained speeds of 85 to 90 miles an hour are necessary for long distances.

It is only in recent months that schedules requiring average speeds as high as this have been attempted for such distances as are involved in the operation of these new Milwaukee trains, while sustained speeds of 90 miles an hour were unthought of almost as recently. In this connection, even the most casual consideration will make it clear that track which rides smoothly and is entirely safe for speeds of from 50 to 60 miles an hour may be neither safe nor smooth riding when the speed approaches 100 miles an hour. Furthermore, while comfortable riding is always desirable, it is essential for high-speed passenger operation.

For these reasons, when these trains were proposed, it became obvious that certain refinements in line and surface would be required which had not been warranted for trains operating on the usual schedules. These observations applied more particularly to the curves, which had not previously been elevated for the speeds at which these trains were to be run. It was also recognized that perfection in line and surface would be even more essential on curves than on tangents.

Accordingly, a complete study of the alinements was made, in which the curvature, elevation and spiraling of all curves were checked. Determinations were made of the practicability of reducing the curvature at certain points, and the desirability of line revisions was considered. With respect to the latter, it was found that only one minor line revision could be justified. This project, near Elm Grove, Wis., had already been in contemplation and was carried out to eliminate two curves and lighten a third.

Character of Line

From Chicago, the line runs almost directly north to Milwaukee, Wis., 85 miles. The country is generally flat and both curvature and gradient are light. In the 78 miles from Western avenue, Chicago, to Powertown, 4 miles from Milwaukee, there are only 27 curves, none of which is sharper than one degree.

In this section there are long stretches where the grades are 0.2 per cent or less, with a few gradients of 0.4 and 0.5 per cent, principally at grade separations, all so short that they do not affect train operation.

From Milwaukee, the line turns to the northwest to LaCrosse, 196 miles. In this section, the drainage is generally to the south or southwest and several important streams are crossed, requiring gradients up to 0.6 and 0.7 per cent over the divides separating the several drainage areas, although elsewhere the grades are much lighter. The topography is gently rolling over most of this distance and there are only 152 curves, with many long tangents between them. Most of the curves are grouped at points where the line follows tributary streams to ascend or descend the divides. Of the total, however, 128 are less than 2 deg., while 16 are 2 deg., 3 are 3 deg., and the remaining 5 lie between 2 and 3 deg.

Follows River Closely

At LaCrosse the line crosses the Mississippi river and follows the west bank to Hastings, Minn., where it again crosses the river and runs on the east side to St. Paul, a total distance of 129 miles. Over most of the distance between LaCrosse and Hastings the bluffs crowd close to the river bank, and to gain support for the roadbed it was necessary to follow very closely the sinuosities of the bluff line, with the result that between LaCrosse and St. Paul, there are 396 curves, all but 30 of which, however, are 2 deg. or less, while only 22 are 3 deg. or sharper. As these latter are generally at the river crossings and near junction points they have, of themselves, little influence on the permissible speeds.

Between Chicago and Milwaukee the track is laid with 100, 110 and 130-lb. rail, while west of Milwaukee, the rail is generally 90 and 100 lb., with a small amount of 110-lb. section, with joints of Rail Joint Company and A.R.E.A. standard designs. All ties are treated, generally with creosote, and protected with single shoulder tie plates of Milwaukee design. The rail is anchored against creepage with anti-creepers of the Fair, Woodings, and Stead designs. Gravel ballast of ample depth and full section supports the track, which is well maintained with respect to line and surface. Switches, frogs and crossings conform generally to the standards of the American Railway Engineering Association.

As the first step in preparing the track for the higher speeds called for by the new schedules, 3½ in. was selected as the maximum elevation for all curves. Preliminary to this decision, the accompanying table of elevations and speeds was prepared, the safe speeds for the new trains being based on a height of 76.3 in. for the center of gravity of the new locomotives which haul these trains.

Recent developments in transportation are bringing new problems to the maintenance of way departments of those roads which have placed the so-called super-speed passenger trains in operation. This article describes how the roadway department of the Chicago, Milwaukee, St. Paul & Pacific put up its track in preparation for the world's fastest long-distance steam-operated trains.

As a further preliminary, a test run was made between Chicago and Milwaukee, with a train in regular service, in which the 85 miles were covered in 67 min. 35 sec., at an average speed of 75.5 miles an hour and a top speed of 103 miles an hour for 5 miles. As a result of these studies and the data obtained on this run, it was also decided to elevate all curves of less than 2 deg. for comfortable riding at 90 miles an hour, and to give curves of 2 deg. and sharper the maximum elevation, with suitable speed restrictions to insure comfortable riding.

A. R. E. A. Spiral Used

Recognizing that comfort in riding may be affected as much by the manner of approaching a curve as by the superelevation, special consideration was given to the length of the runoff and the type of spiral to be employed. As a result of this study, the spiral developed by the Track committee of the A.R.E.A. and published in the 1933 Proceedings, was adopted. The rate of runoff selected was 1/3 in. in 39 ft., with a corresponding length for the spiral. In other words, for a superelevation of 1 in., the spiral is 117 ft. long and for 3½ in. it is 409.5 ft. long. Incidentally, it was necessary to change the notching on all track levels in this territory to correspond with the rate of change in the runoff.

North of LaCrosse, all curves sharper than one degree had already been spiraled, as well as some of those of lighter curvature, except at a few points where speeds are restricted for operating reasons. As a result, in lengthening the spirals to correspond to the new standard, it was found possible to keep the throw at the point of circular curve to a

This Curve on the La Crosse Division Can Be Taken Comfortably at 100 Miles An Hour

Tangents Are Short North of La Crosse

maximum of three inches. On the other hand, few of the curves between Milwaukee and LaCrosse had been spiraled previously, so that throws up to 12 in. at the point of circular curve were not uncommon, and they reached 16 in. in a few instances, but in all cases the throw through the body of the curve was much less.

The next question involved the method to be followed in lining the curves. As much time could be saved by string lining, as compared with using the transit, and as the results were considered to be equal to those obtained with a transit, this method was chosen. The A.R.E.A. method of laying out spirals was applied to all curves. In the beginning, however, this method was employed for the circular part of the curve only where the length was 30 chords or less, 39-ft. chords being employed throughout. As the work progressed, this method was used more extensively to include the longer curves as well.

In running a curve, the first work consisted of marking off uniform chord lengths of 39 ft. along the gage side of the high rail, beginning at least five stations out on the tangent beyond the apparent end of the curve and continuing the same distance beyond the far end of the curve. Measurements of track centers, plusses to bridges, highway grade crossings, station platforms and other fixed points were also recorded at this time, as were notes on the distance the track could be thrown either in or out at these controlling points. Following this, the mid-ordinates were measured for each station.

Transit Used

While it is possible for an experienced man "with a good eye for line" to secure good alinement at the ends of the curve without using a transit, it was found that the work was facilitated considerably by using an instrument to insure the correct relationship between the spiral and the tangent. The reason for this was that on most curves which had not been lined recently, there was some distortion of the tangent at the ends of the spirals or of the unspiraled curves.

In some cases it was found that the tangent had been thrown inward in an effort to lengthen the spiral, or to ease the curve, if unspiraled. In others, it had been thrown outward, forming a "dogleg," in an attempt to smooth out the spiral Where the track had been shifted inward, there was always a short piece of tangent off the spiral where the ordinates were zero and then an outward bend to connect with the true tangent. These variations were usually so slight that they were not easily detected in the ordinary operations of string lining, yet they were enough to have a serious effect on the riding qualities of the track at high speed. It was found that, unless the true tangent was extended, the spiral laid out by string lining alone almost invariably headed down this short artificial tangent.

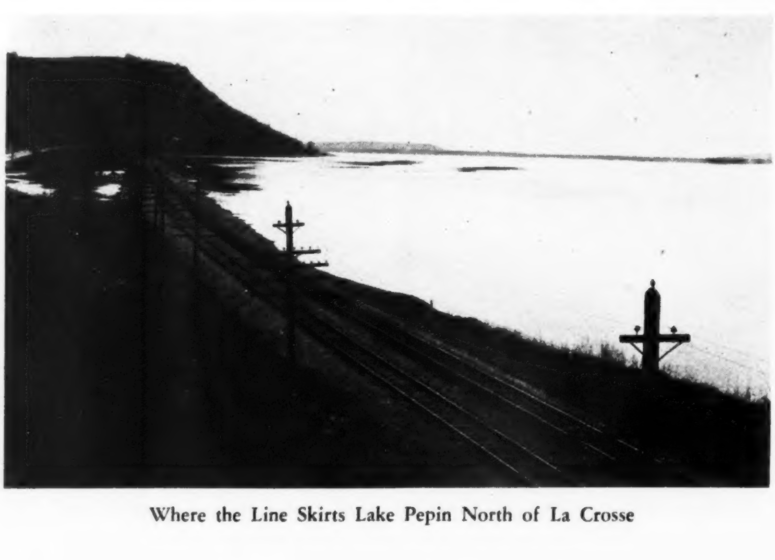
Where the track had been thrown outside of the true tangent, there were minus ordinates to contend with, and it was found that they could not be read with the desired degree of accuracy. For this reason, the new spiral invariably crossed the true tangent, thus introducing a slight reverse curve near the point of spiral. It was thought at first that after the stake for the point of spiral had been set, the tangent could be lined to it with so little change in angle as to be unobservable. It was found that this could be done in some instances, but as the usual case required the lining of only 200 to 300 ft. of track before the string lining was started, experience showed that it was preferable to use the transit, since this saved lining over a much greater distance later to make the tangent fit the stake at the point of spiral.

Another Reason

Another important consideration that led to the use of the transit to correct the tangent at the ends of the curves, was the difficulty encountered in reading the small ordinates accurately. Experience indicated that inequalities in rail wear and slight kinks in line often caused readings that were inaccurate by one or two units, and that as much as two units (1/8 in. or 0.01 ft.) were recorded on track that was on tangent.

In using the transit, it was set up far enough back of the point of curve to clear the outside rail, and alined with the gage line of the rail on the tangent. From the line thus obtained, offsets were measured to the gage line at each string-lining station from the curve to the point of true tangent. These offset readings were positive when the gage line fell inside of the true tangent and negative when outside.

Three general parties were placed in the field to lay out the spirals and line the curves. As there were only minor differences in these organizations and the methods they followed, a description of this work north of



Where the Line Skirts Lake Pepin North of La Crosse

LaCrosse will answer for all. The general organization consisted of 16 men, reporting to a chief of party. The first party considered of six men, divided into two groups of three each. It began at LaCrosse and took ordinate readings on both tracks, one group to each track, recording them on cards specially prepared for this purpose. This party also recorded all data with respect to track centers and controlling points, these being repeated for each track.

Separate cards were used for each curve and for each track, and were sent to the office at St. Paul on the first train after they were filled out. Here the corrected ordinates for the string lining were computed and the cards were sent immediately to the second party, which followed setting the line stakes. The principal reason why the computations were made in the office rather than in the field was that this system reduced the overall time required for setting the stakes. As neither party was interrupted in its regular routine to make the calculations, the 12 men comprising these parties were able to apply their time productively during the entire operation. There was thus no lost motion except the slight delay necessary to get the first batch of cards back to the second party.

Another reason why this system was devised was that time was an essential element in the program. As soon as the decision to carry out the work was made, 4 gangs of 75 men each and 4 gangs of 20 men were transferred to this section of the road to do the necessary track work, and it was important that none of them be delayed. As soon as the cards containing the curve data were received, the second party, also divided into two groups of three men each, started setting stakes. For this purpose, 2-in. white-oak stakes 16 in. long were employed. All ordinate measurements, both original and final, were made with a rule graduated to hundredths of a foot, and the exact center of the track for the new line was determined quickly by means of a small plumb bob.

All points of spiral, of circular curve and of compound curve and the corresponding superelevations, were painted on the rail with white paint. In addition, a single vertical line was painted on the rail opposite every stake through all spirals at both ends of curves and those at points where the curves were compounded. Later, permanent markers, made of 2-in. boiler flues 24 in. long, were placed at all points of curvature change. One end was pointed for driving, while a flat piece of metal 2½ in. by 2½ in. by ⅜ in. was welded across the other end. These plates were deeply stamped with the desired curve and elevation data, for example P.S.-0.0 In., P.C.-2½ In., etc.

As soon as the stakes were set on any curve, the cards for that curve were turned over to a third party consisting of four men, two men working on each track. This party

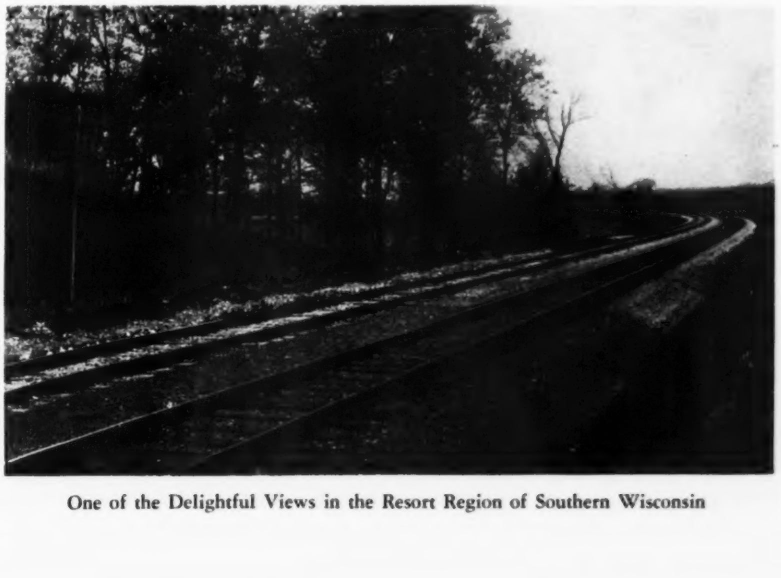
The Bluffs Hug Close to the River

checked the location of the center stakes, the distance between the new center lines and the clearances at all controlling points. Finally, after the track had been thrown, it was checked again to insure that it had been lined accurately to the stakes. At the same time the superelevation was also checked carefully.

It was found that on spirals, where the curvature was changing constantly, it was necessary, in the interest of quick as well as of accurate lining, to set a stake at every 39-ft. station. On the tangents at the ends of the curves a stake every second or third station was sufficient. On the circular part of the curve a stake every second station was sufficient for accuracy, but experience showed that enough time could be saved in lining to warrant a stake at every station. This was

Table of Comfortable and Safe Speeds on Different Curves

Degree of curve	Superelevation inches	Comfortable speed miles an hour	Maximum safe speed Height of center of gravity inches			Overturning speed Height of center of gravity inches		
			84	76.3	75	84	76.3	75
			AREA	Milwaukee type	F-6	AREA	Milwaukee type	F-6
			90 Miles Per Hour					
0°30′	1½	116	145	150	151	245	256	259
1°00′	2½	91	109	113	114	178	186	188
1°30′	3½	81	95	98	98	149	156	157
			70 Miles Per Hour					
0°30′	1½	116	145	150	151	245	256	259
1°00′	2	87	106	110	110	176	184	185
1°30′	2½	74	89	92	93	145	152	153
2°00′	3½	70	82	85	85	129	135	136



One of the Delightful Views in the Resort Region of Southern Wisconsin

true particularly where the throw was considerable and extended entirely around the curve.

In addition to the line revision at Elm Grove, several curves were reduced to one degree to avoid the necessity of placing restrictions on otherwise highspeed track. All companion curves on the two tracks were elevated for the same speeds, regardless of grade conditions, to permit traffic diversions without speed restrictions. Spirals were introduced at all points of compound curvature. If the curvature increased in the normal direction of traffic, the length of the spiral was selected on the same basis as for those joining the curve and the tangent; if the rate of curvature decreased, the length was calculated on the basis of a decrease in elevation at the rate of ½ in. in 39 ft.

Spirals Give Easy Approach to the Curves

Track Surfaced

All curves were carefully gaged and raised an average of one inch, to which was added the amount under the high rail necessary to obtain the desired elevation. A general tie renewal was not attempted, although new ties were inserted where this was considered desirable. The entire 1935 tie allotment was applied on the few curves that required considerable throw. Enough ballast was distributed to care for the surfacing and to complete the ballast section. No ballast was used on tangents, however, except a small amount to fill out places where the shoulder was less than standard. Hand dressing of the ballast consisted only of dressing the cribs, the shoulders on both curves and tangents being shaped by a Jordan spreader equipped for this purpose.

A force composed of 475 men in extra gangs was employed for two months in completing this work. In addition, about 125 section men in addition to the regular section forces, were employed for the same period, mainly between LaCrosse and Chicago, to do such light surfacing on tangents as was considered desirable, although they were employed to some extent on curves also. Between LaCrosse and St. Paul, in general, the relatively small amount of tangent was taken care of by the extra gangs assigned to this district. All the larger gangs were fully mechanized in accordance with the established policy of the Milwaukee. Surfacing was done with the Electric Tamper & Equipment Company's tamping outfits.

All tangents, as well as curves, were lined carefully to insure smooth riding at the speeds which will be maintained, the purpose being to secure the maximum refinement in detail as well as in the general line. As has been explained, the curves were lined to stakes by the gangs which did the surfacing. Few stakes were set for lining the tangents, however, this work being done by several gangs that were organized especially for lining and equipped with Buff & Buff lining transits.

No rail was laid as a part of the program of preparation for high-speed service. In 1928, this road adopted the policy of laying 130-lb. rail between Chicago and Milwaukee as renewals were required. West of Milwaukee 100-lb. has been the standard until this year, the standard section having now been increased to 112 lb. In pursuance of this policy, and in accordance with its normal rail program, approximately 40 miles of 131 (instead of 130) and 112-lb. rail will be laid on this line this year, replacing 90 and 100-lb. rail.

Full speed is permitted on all tangents and on all curves of 1 deg. and less, except where limited for operating reasons. Speed is restricted to 70 miles an hour on curves sharper than 1 deg. up to and including 2 deg. On sharper curves the limit is 60 miles an hour. All speed zones have been carefully outlined, and markers provided to indicate the permissible speed in each zone. Reduce Speed and Resume Speed signs have also been placed at every point where the speeds are to be changed.

In planning and carrying out this preparatory work, three things have been kept definitely in mind. The first is that small inequalities in line and surface, which are not noticeable at the ordinary speeds of operation may cause considerable discomfort at the higher speeds at which these trains will be operated. Incidentally, the Milwaukee is favorably situated with respect to its rail joints. Because of the consistent program of welding to correct battered joints which has been in effect for several years and periodic out-of-face bolt tightening with Woolery power wrenches, the tracks have been maintained in smooth riding condition, so far as the joints can contribute to this result. Likewise, in the routine maintenance of the tracks, Nordberg adzing machines, spike pullers and rail grinders are provided as regular equipment for both rail and special maintenance gangs.

The second thing that has been kept in mind is that for comfortable riding, it is not only necessary to adjust the superelevation on the curve for the speed, but the approach to the curve must be smooth, without causing jar or side swing to the car and with no sensation on the part of the passenger of a sudden application of centrifugal force. To accomplish the latter, it has been a rigidly enforced rule that the superelevation shall begin at the point of spiral and increase directly with the curvature to the point of circular curve and continue uniformly at this maximum around the curve, where it is run off in the same way on the spiral, but in no case does the elevation extend onto the tangent.

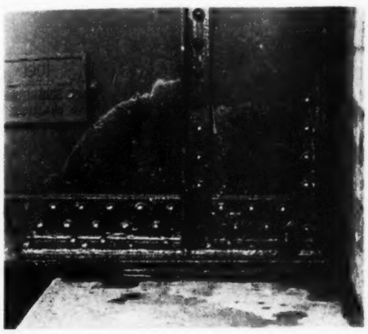
Where schedules call for high average speeds, every minute counts and any reduction in speed means a loss of time that must be made up later by correspondingly higher speeds. For this reason, the third objective was to remove, so far as practicable, all obstructions to maximum speed. In several instances this was accomplished by reducing curves to one degree, which would

(Continued on page 344)

Checking Bridge Corrosion

Mohawk Division of the New York Central applies the "stitch in time" principle to its structures, at small cost

FINDING it difficult to keep up with its normal bridge painting program under the necessarily restricted allowances during the last few years, there has been set up on the Mohawk division of the New York Central, with multiple-track bridges equivalent to approximately seven miles of single-track bridge, a small organization which is going over all of the structures and giving special attention to those parts most subject to corrosion. In this work it is swabbing or painting these parts with oil to check corrosion and to loosen any rust and scale which may have accumulated. This gang of four men was put to work during the summer of 1933. Moving from bridge to bridge in consecutive order, this organization has already given attention to more than half of the bridges.



Oiled in an Attempt to Retard Corrosion—Note that the End Stiffeners Have Been Repaired by Welded on Plates

Corrosion at Ends

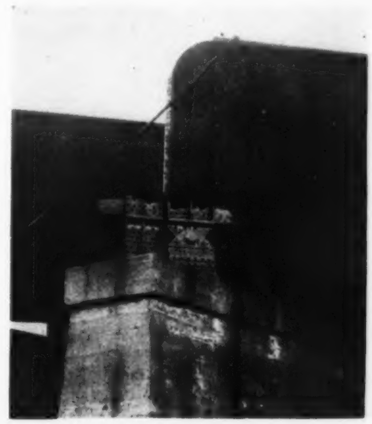
With most of its structures of the ballasted-deck type, the most serious corrosion on the Mohawk division has been about the ends of the structures, where they rest upon the abutments or piers. This is due to the accumulation of cinders, stack soot and other debris on the bridge seats and around the bridge pedestals, shoes, base and sole plates, and sometimes the ends of the superstructure steel itself. As a result, the condition of these parts has been the determining factor in much of the bridge painting of the past. Recognizing this, and the possible serious damage that would occur to its bridges if they were entirely neglected, it was decided to apply oil where most needed. The oil being used has an asphalt base, and is similar to that which the road has applied for a number of years to its rail and track fastenings.

The organization for this special oiling work includes three men and an assistant foreman, who are equipped with boarding and supply cars, and with a motor car for going to and from work. These men, with such hand tools as brooms, rust picks, cutting bars and simply devised dirt hooks or hoes for reaching into inaccessible places, first clean the steelwork and remove all accumulated cinders and debris from about the bridge seats, and then apply the oil. This latter operation is done with ordinary paint brushes and with small swabs or brushes affixed to long handles to get into and about small openings. By far the largest amount of the time of the men is required in the cleaning work, especially in removing the cinders and other accumulated dirt. All loose rust and scale are removed from the steel, but no attempt is made to do a thorough job, it having been found that the oil penetrates and loosens a limited film of rust or scale and effectively retards further corrosion of the underlying steel.

Cleaning Away Cinders and Stack Soot, Which at Many Places Pile Up Several Inches Around the Webb Plate and End Stiffeners

All supplies are kept in the boarding and supply cars, which include a bunk-fitted coach, a box car and a flat car. These cars are moved periodically from point to point as the oiling work moves over the division.

Since practically all of the bridges require some attention, it is estimated that it will take the gang about two years to go over all of the division. If the program is made continuous, however, it is expected that, because of the reduced amount of cleaning which will be necessary on subsequent visits, attention can be given to all of the bridges each year. If such a program is carried out, which is now contemplated, it is felt that positive protection will be afforded to those parts of the bridges which have caused the greatest concern and maintenance in the past.



This Is Typical of the Extent of the Oiling Around the Ends and Bearings of the Bridge Structures

The oiling described is being carried out by men in the bridge and building department under the general supervision of T. P. Soule, general supervisor of bridges and buildings of the New York Central, Buffalo and East, and E. E. Tanner, supervisor of bridges and buildings of the Mohawk division.

These Roadway Buildings Are Typical of the Many on Which Prepared Roofing Is Applied

This is the fifth article of a series setting forth the instructions covering the methods of applying and maintaining roofs on the Northern Pacific, which this road has issued in the form of a manual of roofing practices. The present article deals with the application and maintenance of prepared roofing.

Roofs

Applying Prepared Roofing

PREPARED roofing is considered to be an important material by all railways and is used widely for covering many types of buildings. While this is probably the simplest form of roofing to apply, many installations have proved unsatisfactory, usually because the work was done hurriedly or the workmanship was poor for other reasons. Furthermore, maintenance is an important element in obtaining satisfactory results from this roofing. The detailed rules for the application of prepared roofing which are included in the Northern Pacific's manual follow:

Prepared roofing is not intended to be used on flat surfaces and should not be applied on roofs having a pitch less than 4 in. to the foot, to those surrounded by parapet walls or where the stoppage of leader outlets will result in water backing up and remaining on the roof.

Before applying prepared roofing, the roof decks shall be swept clean. All loose boards shall be nailed securely in place and all knot holes and other openings or cracks ¼ in. or more in width shall be covered smoothly with sheet metal nailed securely in place on one side only. All nails or other projections that might pierce the roofing shall be removed.

All materials shall be housed properly or covered in such manner as to protect it adequately from the elements or other sources of damage.

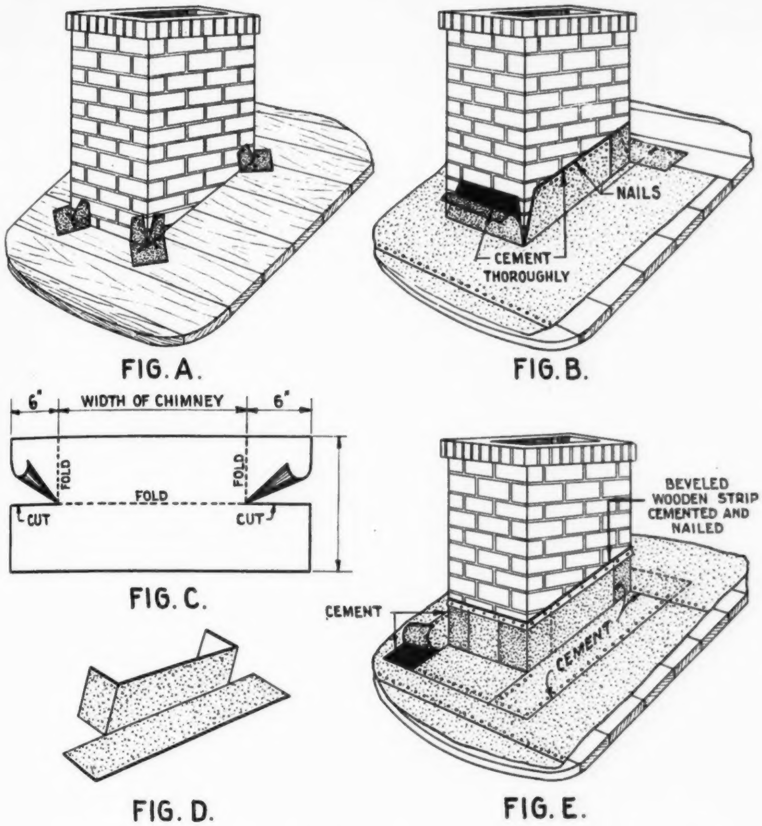
Prepared roofing shall not be applied when rain is falling or during weather cold enough to prevent the work being done in the proper manner.

When preparing the roofing for use, first remove the fittings from the center of the roll. Then unroll on a flat, smooth surface, cut into lengths of from 12 to 18 ft. and allow it to flatten. Finally, reroll loosely in the reverse before making the application.

Workmen should wear rubbers or rubber-soled shoes when applying prepared roofing; it is likely to be badly damaged if the men are permitted to wear heavy leather soled shoes.

Prepared roofing shall meet the requirements of the Northern Pacific's Specifications for Asphalt Prepared Roll Roofing which requires that every roll shall be supplied with the necessary nails and cement necessary for application. If additional fittings are needed, they shall meet the following requirements:

Nails for applying prepared roofing directly to roof decks shall be galvanized, barbed, ⅞ in. long, 11 gage and have heads not less than $\frac{7}{16}$ in. in diameter. Nails for applying roofing over wood shingles shall meet the same requirements, except



Details of Chimney Flashing for the Application of Prepared Roofing

that they shall be 1½ in. long.

Plastic roofing cement shall consist of asphalt containing asbestos fibre and shall be of the proper consistency to allow it to be worked with a putty knife or trowel.

Applying to Roof Decks

Prepared roofing may be applied either with the sheets running horizontally, i.e., parallel with the eaves or vertically, i.e., at right angles to the eaves. The latter method shall be limited to pitches greater than five inches to the foot.

Valley sheets shall be laid first. To do this, cut a sheet of roofing in two strips, one of which is 16 in. wide and is to be used for the lower valley sheet and the other to be 20 in. wide for the upper valley sheet. These strips shall be folded carefully to conform to the angle of the valley. The laying of the first sheet shall start at the bottom and as it is laid, it shall be nailed on six-inch centers along the edges and shall be butted. The entire width of the first sheet shall then be coated with lap cement into which the second or top sheet shall be bedded carefully. Where horizontal seams are necessary, the end of the top sheet shall be lapped 6 in. and cemented but not nailed. The top sheet shall be nailed along the outer edges on 6-in. centers.

One thickness of roofing shall be laid over the entire roof surface overlapping the valley sheets to within one inch of the valley angle and extending up all vertical surfaces to be flashed not less than four inches. The edges of the roof shall be finished by carrying the sheets over the sides and ends of the roof boards and ¼ in. beyond to form a drip edge. Long seams shall be lapped 2 in., cemented and nailed on 2-in. centers in a line ¾ in. back from the edge. The end seams shall be lapped four inches and cemented and two rows of nails shall be used, the first, ¼ in. and the second, 1¾ in. from the edge, spaced on two-inch centers and staggered.

In the valley angle, the roofing shall be cut in true alinement to the rake of the line of the valley and shall be cemented and nailed as for long seams.

Edges shall be nailed on two-inch centers and care shall be taken when bending the roofing to see that it is not broken. If necessary, heat may be applied to soften it sufficiently to accomplish this.

When roofing is laid horizontally, it shall be nailed from the centers of the sheets toward the end. When laid vertically, the nailing shall be done from the top of the sheets down.

It is especially important that all laps be cemented thoroughly and that the edges of the laps be rubbed down carefully to insure well-cemented joints. Coat all nail heads with lap cement. At ridges, the sheets shall be lapped not less than two inches and cemented and nailed as already described. A strip of roofing 18 in. wide shall then be cemented and nailed over the ridge in the same manner, with 9 in. projecting over each side of the ridge.

Flashing

Where vertical wall surfaces are encountered, it is desirable to provide a fillet in the angle between the roof deck and the wall. To do this, turn the roofing up four inches along the vertical surface, fitting it snugly into the angle, attach the sheet to the wall with lap cement. Next, cut a strip of roofing 12 in. wide and fit it into the angle so that the upper edge covers the first joint in the wall above the turned-up roofing sheet. Fasten the upper edge of this strip in place by means of a bevelled wooden cleat which shall be secured to the wall by nailing. Cement and nail the lower edge of this strip in the same manner as is done with laps in the body of the roofing. Carefully point the joint between the top of the wooden cleat and the wall with lap cement. Unless this is done properly, leaks are likely to develop at the flashing. If the vertical wall is finished with drop or bevelled siding, the bottom board will serve as cap flashing if the roofing is turned up and properly fitted under it.

Applying Flashing

The method of flashing around chimneys is shown in detail in the illustration. To apply this flashing, cut pieces of roofing about 6 in. square, fitting and attaching them snugly around the corners of the chimney, as shown in Fig. A, then lay the roofing in the usual manner, cutting it so that it may be turned up snugly against the chimney about 4 in., as shown in Fig B. Attach the turned-up portion of the roofing with lap cement, being particularly careful at the corners. Special care should also be used to insure that the roofing does not tear at the corners.

For use on each side of the chimney, cut a strip of roofing 12 in. wide, making each strip 12 in. longer than

the side of the chimney to be flashed. These strips should be cut as shown in Fig. C, and folded as shown in Fig. D to fit the four sides of the chimney snugly. The strips shall also be folded to suit the angle of the roof. Next, place the strips around the four sides of the chimney, as shown in Fig. E, so that water will run over the laps. Cement these strips thoroughly both against the chimney and to the roofing. Next fashion the upper edge with a bevelled wood strip, securely nailed. Then apply cement over the wooden strip to prevent water getting in. Finally, nail the lower portion through the cemented lap on two-inch centers, as shown in Fig E. Special care shall be taken when cementing flashings; otherwise leaks are likely to develop.

Applying Over Roof Shingles

Prepared roofing should not be applied over old wood shingles except on small and unimportant buildings, such as tool houses, coal houses, etc. Where it is to be applied in this manner, the roof surface should be gone over and all loose shingles nailed. All badly curled shingles should be split and nailed flat to make the surface as nearly smooth as practicable, in the manner already described.

At gables and eaves the shingles should be cut off flush with the roof boards to permit the roofing to be properly attached to the edges of the roof.

In making the application, proceed as specified for making the application directly to the roof decks.

Owing to the great likelihood of damage, the finished roof should not be walked upon. The unsupported roofing material at the shingle butts is easily damaged.

Maintaining Prepared Roofing

Recognizing the importance of proper maintenance of roofing of this type and the fact that its life may be shortened appreciably by neglect, the section of the manual dealing with maintenance not only lays down rules for maintaining roofs of this type, but also discusses the reasons why they are necessary. This section of the manual follows:

In general, the use of prepared roofing is confined to buildings not large in size or permanent in character. On the other hand, we have many thousands of squares of roofing of this type in use on warehouses, sheds, etc.

Prepared roofing, as used on the Northern Pacific, is composed of a felt sheet saturated with asphalt and coated on the exterior surface with thin layers of asphalt of a heavier consistency. These surfaces are then dusted with talc, mica or some other mineral to prevent sticking in the roll.

Asphalt in its natural state is a thick, bituminous substance having about the consistency of roofing pitch. To liquefy it so that it can be used as a saturant for felt, it is "cut back," or thinned, with light oils or solvents. Upon exposure to the elements, these light oils evaporate eventually, leaving the roof hard and dry. Generally, it is at this stage that leaks develop and thought is given to surface treatment with one of the many roof dressings. This brings up the question of the proper type of dressing to use, bearing in mind that the object of a dressing is to restore the roof surface as nearly as possible to its original state. This can be accomplished only by using a dressing that is thin enough to be absorbed by the dried-out felt. If it is applied in time, one coat will generally be sufficient; if delayed too long, however, two or more coats may be necessary before the roofing is refilled and a film or glaze is shown on the surface.

There is no definite rule that can be followed to determine when the first dressing should be applied or how frequently thereafter. Local conditions will have a decided effect but, as a general rule, the first application should be made within two or three years and as often thereafter as may be found necessary.

Too Often Delayed

Too often, the application of the dressing is delayed so long that the roofing is practically ruined and the thin coatings seemingly are ineffective, for reasons already given. For this reason, the dressings most generally used by other than professional roofers are of the thick type, quite often containing some asbestos fibre and sold under various trade names. Dressings of this type are simply a combination of asphalt and thinning oil, with the addition of the asbestos fibre. They are quite thick and penetrate the felt to only a small degree but for a time form a rather plastic coating over the surface, by reason of which an impression is obtained that they are more effective than they really are.

The better types of dressings, which do not contain asbestos fibre, can be purchased from any of the reliable companies producing asphalt products. Those responsible for maintaining roofing should keep a supply on hand which should be purchased in barrel lots in accordance with the Northern Pacific's Specifications for Liquid Coating for Asphalt Prepared Roofing. This dressing should be applied at intervals frequent enough to keep the roof in good condition.

The weakest point in all roofing is the seam or lap and this is particularly true of prepared roofing, by reason of the small lap used and owing to the fact that nails are driven through them and left exposed. Where trouble develops in the seam, a good method of correcting it is to apply plastic roofing cement and embed in it over the lap a four-inch strip of asphalt-saturated waterproofing fabric or felt and finish off with a surface coating of plastic cement which should overlap onto the roof surface about one inch around all edges.

The next article will be a general discussion of the characteristics of built-up roofing and of the materials that enter into their construction, and will outline certain precautions that are necessary if best results are to be obtained from this type of roofing.

Putting Up Track

(Continued from page 340)

otherwise have required speed reductions to 70 or even 60 miles an hour, but which now permit the maximum speed to be maintained for long distances.

Aside from the track, provision was made also to insure against excessive delays in taking water by the installation on the new locomotives of tender cisterns of 13,000 gal. capacity, so that it will be necessary to take water only at LaCrosse and Milwaukee. At these points, Sheffield water columns deliver 2,500 gal. of water per minute. As the locomotives are oil burning and the tender oil tanks have fuel capacity sufficient for the entire run, fuel delivery is not a factor in the schedules of these trains.

All of the work in preparation for these faster schedules was done under the general direction of W. H. Penfield, engineer maintenance of way (now chief engineer) and C. T. Jackson, assistant engineer maintenance of way (now assistant to chief engineer). Walter Lakoski, division engineer, was in charge of lining the curves between Chicago and Milwaukee; H. B. Christianson, division engineer, had charge of this work between Milwaukee and La Crosse; and E. W. Bolmgren, assistant engineer, was in charge between La Crosse and St. Paul.

Many Influences Reduce Tie Requirements*

By Elmer T. Howson

Editor, *Railway Engineering and Maintenance*

TWENTY years ago, railway requirements for crossties approximated 120,000,000 annually. In 1933 their purchases totaled only 30,000,000 ties, while last year they amounted to about 52,500,000. How much of this reduction has been due to the enforced curtailment of purchases resulting from the depression? Obviously it has been brought about in very real part by this condition, for the railways have curtailed expenditures in every possible way. One must not overlook the fact, however, that crosstie requirements were declining before the depression broke, purchases in the boom years of 1928 and 1929 being 10,000,000 ties less per year than during the previous decade. Since railway purchases as a whole reached high levels in these years, the decline in the demand for crossties cannot be attributed to a lack of funds. The explanation for this trend must be found elsewhere.

Primary Influence

The primary influence contributing to this condition is the rapidly growing practice of treating ties. Second only to treatment is the raising of the standards for crossties. Never before have the railways so generally purchased ties of such excellent quality and protected them so carefully against decay through seasoning as during the last decade. Furthermore, ties are now given better care in installation and service. They are no longer drawn into place with picks or abused by excessive adzing. A considerable proportion of the ties applied have been prebored and pre-adzed and ties generally are being protected by tie plates of more liberal dimensions.

But these are not all of the influences that are tending to reduce tie requirements. One of the major factors is the change in the trend of our national development in recent years—a change that has come on us so gradually that the full effects are not yet realized. From the time when the Baltimore & Ohio first struck out for the west in 1832, until about 1916, railway development in this country was primarily extensive—the construction of new lines to reach areas without facilities or in need of additional facilities. As much as 6,000 miles of new lines have been built in a single year, while during the nine years from 1899 to 1907, inclusive, an average of more than 5,000 miles was built annually. During the same period, railway traffic was doubling about every 10 years, requiring large mileages of additional main and yard tracks.

However, beginning about 1910, the mileage of new line construction declined steadily until even in the boom years of 1927-8-9, it averaged only 625 miles per year, or scarcely more than 10 percent of that of a quarter century before. Furthermore, the decline in the rate of increase in traffic and such developments as centralized traffic control that make for more efficient use of tracks, resulted in a decline in the need for additional trackage. As a result, the construction of new tracks, which had required as many as 30,000,000 ties a year around the beginning of this century, came to a standstill.

Another influence that must not be overlooked is the growing mileage of abandoned lines. Year by year this mileage has increased until in 1933 the total reached 1,876 miles and in 1934 mounted to a new high of 1,995 miles, while in those same two years only 24 and 76 miles, respectively, of new lines were completed. Since 1917, a total of 15,706 miles of lines have been abandoned, while 10,148 miles have been built, a net decrease for the period of 5,558 miles. The abandonment of this mileage is not only reducing the demand for replacement ties, but is also releasing a very considerable number of usable ties which are being reinserted in renewals.

New Requirements

Within the last year another development, the initiation of high-speed train operation, bids fair to become of far reaching importance to the railways. Passenger trains of standard as well as of new streamlined designs are now in regular operation at speeds materially higher than heretofore scheduled anywhere in the world. Neither is the speeding up of trains confined to these spectacular runs, for it is evidenced in the tightening of schedules throughout the country. In addition, freight trains are now operated as a matter of daily routine at speeds higher than were considered desirable for passenger trains only a few years ago.

Such schedules require stronger tracks. They also require a track that will maintain greater refinement of line and surface. These requirements are giving impetus to the use of larger ties and are accelerating changes in tie-plate design, including both an increase in dimensions and the practice of fastening the plates rigidly to the ties with lag screws or cut spikes. These refinements make for longer tie life.

One of the lessons which the railways have learned from the depression is that the disturbance of track should be reduced to the minimum. It is only on this ground that one can account for the present excellent riding condition of much track after five years of continuous undermaintenance. The beneficial effect on the ties of this apparent neglect has been marked, for the continued disturbance of track is highly destructive to crossties. There are many who believe that we are approaching the time when track will be given a major overhauling at relatively long intervals and the replacing of individual units will be reduced to the minimum in the interval. To the extent that this lessens the destruction of ties, it may be expected to extend their life and reduce the requirements for renewals.

Another Refinement

Still another indication of the steps that are being taken to extend the life of ties is the precaution that has been adopted by one road of assigning an inspector to each rail-relaying gang, whose duty it is to see that all unnecessary abuse of ties incident to rail-renewal operations is eliminated. In such work, where every effort of a large gang is directed towards production, as measured by the amount of rail relaid per day, it is not surprising that the destruction of ties may be hastened by hurried and excessive adzing, by careless plugging of spike holes, by unnecessary spiking around turnouts, etc. It is the function of this inspector to curb such practices and to promote care in all operations affecting ties.

In all of these various practices, it can be seen that we are moving rapidly into an age of refinement in the handling of crossties in which one precaution after another is being introduced to reduce destruction and extend tie life.

*Abstract of a paper presented before the Railway Tie Association at St. Louis.

Adzes

Can They Be Standardized?

This is the seventh article of a series dealing with the multiplicity of designs in track materials and tools. Previous articles have covered the following subjects:

November—General Problems
December—Rail
January—Track Wrenches
February—Tie Plates
April—Lining Bars, Tamping Bars and Claw Bars
May—Rail Joints

Track bolts and nuts will be discussed in the July issue.

THE adze was one of the earliest tools to be employed in track work, having been included in the equipment of track gangs practically ever since wooden ties first came into use. It is also a relatively simple tool. For these reasons, one might reasonably anticipate that by this time the track adze would have been developed to a single design, or at most, to a few more or less standard designs. Yet in number and variety of designs, among track tools, it is exceeded only by the track wrench and the lining bar.

These designs differ with respect to the width, length and shape of the blade, and to a lesser degree, in its thickness as well. Some designs have a full head and others a half head, some have no head and still others have either "pole" ends or hammer ends. Even within each type there are many variations in the shape and size of the head.

Eyes Differ

There are equally wide differences in the size and shape of the eye. In general, eyes are either oblong (rectangular) or oval, although some roads prefer a round eye, while in a few instances they are practically square. Dimensions and taper differ in so many particulars that they create an astonishing number of variations in this detail of adze design. In a recent inspection of a number of adzes, all of which had rectangular eyes but no two of which had dimensions that were exactly the same, the fact was disclosed that despite the varying dimensions of the eyes, every adze in the lot was being used with identically the same handle.

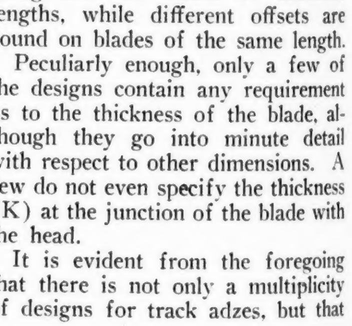
Blades vary in length from 5 in. (one design calls for 4½ in.) to 11 in., these measurements being from the bottom of the eye to the cutting edge. In not a few of the designs, the length of the blade differs by only ⅛ in., while in several the difference is as little as $\frac{1}{16}$ in. Likewise, variations in the width at the cutting edge range from 3 in. to 6 in., with a few designs slightly wider, and with many differences as small as ⅛ in.

It is obvious that these variations in length and width combine to produce a still greater number of variations in the shape of the blade. This number is still further increased by the fact that different roads are using radii varying from 10 to 25 in., with a few designs requiring radii both above and below these limits, for the curves which outline the blade. Again, some of the designs call for the sides of the blade to be straight for 1 to 3 in. back from the cutting edge.

Another detail in which considerable difference is found is the "anchor" or curve of the blade. Some roads specify only the offset (G) for the cutting edge, measured from the outer line of the head, but do not specify the radius of the anchor curve; others specify both, and still others call for a variable radius. It might be expected that the anchor curve would bear some relation to the length of the blade and the offset, but no such relation could be found in the designs which were studied. In fact, the offset itself apparently bears no relation to the length of the blade, the same offset being used on blades of different lengths, while different offsets are found on blades of the same length.

Peculiarly enough, only a few of the designs contain any requirement as to the thickness of the blade, although they go into minute detail with respect to other dimensions. A few do not even specify the thickness (K) at the junction of the blade with the head.

It is evident from the foregoing that there is not only a multiplicity of designs for track adzes, but that



many of these designs differ by so little or in such inconsequential details that these differences do not affect the utility of the tool. It is obvious, of course, that a blade which is of the proper length for use with 60 or 80-lb. rail will be too short for use with 131-lb. rail and that, conversely, a blade that is of the right length for 131-lb. rail may be unwieldy when used in connection with lighter rail. But would a trackman be able to distinguish any difference in use between two adzes having blades $7\frac{1}{2}$ in. long and $7\frac{9}{16}$ in., respectively? Again, would he be able to detect any difference between two blades having widths of 4 in. and $4\frac{1}{8}$ in., respectively?

Other Comparisons

Similar comparisons can be made with respect to other dimensions, including the height (T) to which the blade is ground, the radius (R2) outlining the blade, the depth (F) of the eye, the dimensions and taper of the eye and numerous other details, few of which have any bearing on the efficiency or utility of the tool. As an indication of how inconsequential some of these differences are, the accompanying table has been prepared to show the dimensions of 15 different adzes which are being manufactured currently. This table gives only a slight indication, however, of the total number of designs which characterize this simple tool. While the designs for adzes are not changed with the same frequency as those for some track tools, the most striking fact with respect to many of the changes that are made is that there is no apparent reason for them, since they occur in minor details which have no effect on the utility of the tool.

This raises a question whether an engineer should enjoy complete freedom to follow his own ideas in design; why he should not change his designs as often as he sees fit to do so; and whether there are any disadvantages in the multiplicity of designs which has been pointed out. Again, since a large number of roads, including some of those that also use the A.R.E.A. designs, have their own designs for adzes, the further question arises as to whether there is any advantage in two or more roads using identical designs for adzes.

From the very nature of the work upon which it is used, a track adze is subject to considerable abuse. A railway is interested primarily, therefore, in getting a tool that will stand up under this abuse and do the work satisfactorily. Like other track tools, adzes are not interchanged between roads, but are used solely on the road that purchases them. Furthermore, the stores department seldom carries a larger stock of this tool than is required for current needs, and those that are distributed are used until they are worn out. For these reasons, frequent changes in design have no effect on the number of tools in the hands of track gangs, in the size of stores department stocks or in the volume of purchases.

Before arriving at any conclusions, however, one should ascertain how a multiplicity of designs and frequent changes in design affect the manufacturer and how they react, through him, on the railways. Adzes are made by the forging process; hence they require the use of dies for shaping them and as there are several operations in their manufacture, these will be described briefly.

Many Dies Required

In the drop-forging process, the heated bar first passes through the eye-forming machine, after which the blade is shaped and trimmed, and finally the anchor is formed. These operations require three eye punches and three dies, one forging or shaping die, one set of trimmer dies and one anchor die, a total of three punches and six dies. Each design of eye necessitates a complete set of punches and dies; each design of blade requires a separate forging die, although blades of varying length can be made on this die, provided they are all of the same design; and a separate set of trimmer dies must be provided for each length and width of blade or change in its contour. Finally, every change in the anchor radius or offset necessitates a different anchor die.

A set of forging dies costs $350; trimmer dies cost $85 a set; anchor dies around $85; and a punching set for the eye $150, or a total of $670 for each design of adze. In addition, the cost of removing a forging die from the machine and replacing it with another is $8.50, the cost for trimmer and anchor dies being comparable, while a similar change of the eye-forming set costs $14. This latter figure includes no allowance for the production loss of the machines or delays to other shop operations while changes are being made, but represents only the actual labor cost of making the changes.

In the press-forging process, the eye is formed in the same way as in drop-forging and the cost of the eye set and of changing it are the same as for the latter. Only one set of dies is required for the remaining operations, however, as the blade is shaped to dimension and the anchor formed in one movement. The cost of a press die is around $100 and the cost to change it out of the machine is $30.

From the foregoing it is evident that the die costs for this tool are high. Furthermore, when a road changes its design, a new set of dies must be made up, for, although the former design then probably becomes obsolete, a manufacturer can seldom discard the old dies, for it is not uncommon for a road to re-order tools of a design that has been dormant for a number of years. Production costs are greatly increased, therefore, by reason of the large investment in dies which a manufacturer must carry, and by the relatively frequent changes in design, which invariably require new sets of dies. It should be kept in mind also that while this discussion relates specifically to adzes for trackmen's use, carpenters' adzes are also required for bridge and building work and that there is as great multiplicity of designs for this group as for the trackman's adze.

In common with other track tools, the cost of production for adzes is

Eighteen Adzes—How Many Differences Can You Find?

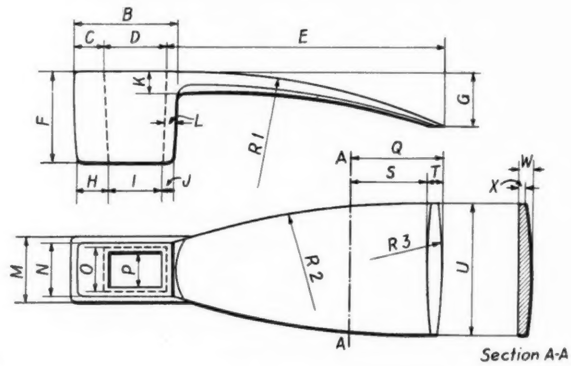
materially increased also by the frequency with which orders for small lots are received, many calling for as few as 6 to 12 tools. As an example of the costs which a manufacturer must assume, a road recently placed an order for 1½ doz. adzes of an entirely new design. It was found, however, that it differed from that of another road only in the radius of the curve forming the contour of the blade. This difference in the radii created a maximum departure of 1/16 in. between the two curves, increasing the overall width of the blade by ⅛ in. about the middle of its length, but running to zero about 1 in. on each side of the point of maximum departure.

To avoid spending the money necessary for new dies, the manufacturer took a chance and used the dies for the other road's design in making up the tools. When the inspector found the difference, he rejected the tools. It was pointed out that the variation was so slight that it did not affect the utility of the tool, but he still refused to accept them. It was then explained to him that since the order was a small one, the cost of making new dies would have amounted to about $37 a tool. On this showing he finally agreed to accept the lot, provided the manufacturer would grind the contour to the proper radius. It is quite evident that the result of this transaction was recorded in red.

Owing to the multiplicity of designs which characterize this tool, a manufacturer cannot afford to stock all of the designs he manufactures, not only because of the warehouse space involved, but because of the largely unproductive investment it would represent. In addition, he always faces the possibility that a design will be changed without notice, thus having any stock he may have made up in advance left on his hands. Experience has taught him that when a road changes its design, it is extremely reluctant to accept tools of the former design, although the stock may have been made up expressly to accommodate it.

For these reasons, adzes are seldom made until the order is received, and then only in the quantity called for, although it is not uncommon for small orders to come in only a few days or a few weeks apart. The manufacture of adzes, as of most other track tools, therefore, becomes seasonal, and the manufacturer is unable to take advantage of slack seasons to build up stocks from which he can draw when many roads send in orders for tools which they need at once.

A concrete example of the multiplicity of designs is shown in the accompanying illustration of 18 different adzes which were being made for the same number of roads, in a single plant on the day the photograph was taken. A close study will disclose five different types of head and three shapes of eyes, while the variations in the width and length of the blades are easily apparent. In addition to these easily distinguished differences, there are many minor variations, some of which could not be detected without a template. It is worthy of note that in this group, no two of the eyes have the same dimensions, although in several of them the differences are slight. It will also be noted that in some instances the cutting edge is ground straight, while in others it is rounded.



B	3-1/4	3-1/4	3-7/8	3-5/8	3-1/4	2-7/8	......	......	8	3-9/16	4-1/2	3-3/4	3-1/2	3-15/32	3-7/16
C	1	1-1/16	1-1/8	1-3/16	15/16	3/4	1	1-1/8	4-1/2	1-1/16	1	1	7/8	1-1/16	1-1/8
D	2	2	2	2	2	2-1/16	2	2-1/4	3	2-1/16	2-3/32	2-5/16	2-1/4	2-5/32	2
E	7, 8, 9	6-7/16	10-5/8	6-5/16	6-11/16	7-1/8	8	6-7/8	7-1/2	6-13/16	9-7/8	7	5	10	8-1/2
F	2-3/4	2-3/4	3	2-3/4	2-3/4	2-11/16	2-11/16	3	2-3/4	2-5/8	2-13/16	2-7/8	2-1/2	3	2-7/16
G	1-5/8	1-5/8	1-3/4	1-5/8	2-5/16	1-5/8	1-5/8	1-1/4	2	1-7/8	2-1/16	1-7/8	1-1/2	2	1-9/16
H	1	5/16	1	1	3/4	1/2	1/4	1	3/8	1-1/16	7/8	4	5/8	1	7/8
I	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-11/16	1-3/4	2-3/4	1-11/16	1-27/32	2-1/16	1-7/8	2	2
J	5/16	5/16	1/2	5/16	1/4	1/4	3/8	1/4	3/8	3/8	1/2	7/16	5/16	9/16	5/8
K	5/8	5/8	......	......	3/4	......	5/8	5/8	1/2	......	......	1/2	9/16	3/4	7/8
L	3/8	3/8	......	......	......	......	......	1/2	1/2	7/16	9/16	5/8	7/16	1/2	7/16
M	2	2	2	2	1-11/16	1-15/16	2-1/8	2-1/8	1-1/4	2-3/16	2-1/16	2-1/4	2-1/4	2-1/8	2
N	1-5/8	1-5/8	1-3/4	1-5/8	1-7/16	1-1/2	1-11/16	1-5/8	1	1-13/16	1-11/16	1-7/8	1-7/8	1-11/16	1-9/16
O	1-3/8	1-3/8	......	......	......	1-3/8	1-3/8	1-1/4	......	1-7/16	1-9/16	1-5/8	1-9/16	1-7/16	1-3/8
P	1-1/8	1-1/8	1-1/8	1-1/8	1	1-1/8	1-3/16	1-1/8	1-3/4	1-1/16	1-5/16	1-3/8	1-5/16	1-3/16	1-5/16
Q	3	4	......	......	......	......	......	......	......	2-3/4	3	2-1/2	2	3-3/4	3-1/4
R1	21	13-1/2	......	......	......	16-1/4	......	......	......	19	15	14	9	18	20
R2	15-1/4	12-1/2	......	......	10-3/16	......	......	......	......	11-1/2	25	21	12	26	22
R3	12	......	......	......	17-1/4	......	10	......	......	9-1/2	16	13-1/2	20	14-1/4	11
S	2-1/2	......	......	......	......	......	......	......	......	2-1/16	2-1/2	2-1/8	......	3-1/4	2-7/8
T	1/2	5/8	......	......	3/8	1/2	......	1/2	1/2	11/16	1/2	3/8	......	1/2	3/8
U	4	5	4	4-1/2	5	3-1/2	4-1/8	5-1/8	4	5-7/8	3	3-3/8	6	4-1/4	3-3/4
W	15/32	15/32	......	......	......	......	......	......	......	1/2	1/2	7/16	1/2	17/32	7/16
X	7/32	7/32	......	......	......	......	......	......	......	1/4	7/32	7/32	5/16	1/4	1/4

Variations in the Designs of Track Adzes—All Dimensions in Inches

It is obvious from the above that this multiplicity of designs and the system of ordering and manufacturing tools which it fosters are the cause of much waste, while also resulting in delays in making deliveries. It is equally obvious that they increase the price which roads must pay for their tools, since all of the costs of production, whether the manufacturing operation is efficient or wasteful, must ultimately be passed on to them.

In view of the unnecessarily high cost of production entailed by the present multiplicity of designs, it is logical to inquire whether adzes can be standardized. An adze is a rela-

tively simple tool; yet in designing it approximately 25 dimensions must be specified, and a change in any one or more of these may result in an entirely new design. It has been shown, furthermore, that some of these dimensions have no bearing on the utility of the tool and that in the remainder small differences do not affect its use.

Will the railways be willing to accept a rigid standard for track adzes? At present, the 8-in. length of the A.R.E.A. design accounts for about 50 percent of the total production. This statement must be modified somewhat because a number of roads, while accepting the general features of this design, retain their own designs for eyes or heads or specify a slightly wider or narrower blade. The remaining 50 percent of the production is made up of the great variety of designs which have been discussed, including the 7-in. and 9-in. lengths of the A.R.E.A. adzes.

While the adze is not intended as a percussion tool, and many maintenance officers believe that it should never be used as such, preference with respect to the head is so deeply rooted that it seems improbable that a single design, especially if it calls for no head, can be expected to receive wide acceptance. There seems to be no insurmountable reason, however, why the designs for the head cannot be reduced to two or, at most, three.

One Design of Eye

Likewise, there does not appear to be any logical reason why the design for the eye cannot be reduced to a single standard. At present, not a few roads that are using adzes with blades of different width or length, specify a single design of eye, to avoid confusion in the distribution of handles. Furthermore, despite the astonishing multiplicity of designs for the eye, the absolute dimensions fall within remarkably narrow limits.

It has been shown that there is need for blades of different lengths. But why the range in this dimension should extend from 5 in. to 11 in. is not clear. It is still more obscure why lengths of 6⅞ and 6 15/16 or of 7½ and 7⅝ should be chosen when preparing designs for adzes. Certainly these minute differences do not add to the effectiveness of the tool. Yet length of blade is a matter of deep-seated preference on many roads, which must be taken into account in any standardization of adze design. It would seem, however, that these lengths could well be reduced to a few, say three or, at most, four.

Recently there has been a trend toward the use of narrower blades for track adzes, although preference for the wide blade still persists and must be taken into account. Yet it is difficult to present any logical reason why difference of ⅛ in. or even ¼ in. should be specified. It would seem that two or, at most, three widths would be sufficient to meet all requirements, instead of the 12 or 15 now demanded. The same situation exists with reference to the anchor, which it should be feasible to reduce to not more than two designs. These facts, the tenacity with which many engineers retain their preference for their own designs and the natural reluctance which has been pointed out, to accept rigid standards, make it improbable that a single design can be expected to receive wide acceptance.

Half-Way Point

This leads to the question whether there is some half way point to which it is practical to go in overcoming the present multiplicity of designs and the economic waste which it entails, while yet retaining sufficient latitude to permit a choice which will meet the needs or preferences of individual roads. If, as has been pointed out, the eye can be reduced to a single design without affecting the utility of the tool, and other details can be greatly simplified and still retain all of the fundamental features of the present diversity of designs, the total number of designs could be reduced to a relatively few, in addition to which attention could then be directed to the possibility of still greater simplicity.

Is rigid standardization necessary for economy? In other words, is there a limit in the number of designs beyond which there is little further economy from standardization? It has been shown that two forms of waste occur in the manufacture of adzes. The first results from the inability of the manufacturer to build up a stock during the dull season from which he can draw during the busy season, thus preventing him from placing his plant on a uniform production basis. Again, both because of the multiplicity of designs and of the number of separate operations involved in the production of an adze, he is compelled to carry a large stock of expensive dies, many of which he is unable to amortize. Furthermore, he is compelled to make frequent changes of these dies in the several machines as he fills orders for one road after another. For these reasons, the cost of producing adzes is relatively higher than for other tools, and may actually be more than he receives for them. If simplification could be achieved along the general lines suggested, it would reduce the number of dies to comparatively few and would correspondingly reduce the number of changes that would be necessary. It would also enable a manufacturer to make up a stock of the limited number of designs during the dull season to meet the demands of the busy season.

Rigid standardization is not necessary for economy, for if the number of designs can be reduced to a few, a manufacturer will be able to effect the same economy in production that would be possible through concentration on a single design. At the same time, if this reduction is made in such a way as to retain all of the fundamental features of the designs which they replace, and provide a suitable selection to meet the diverse needs of different roads, the designs will more readily gain universal acceptance. Simplification in the design of adzes possesses, therefore, all of the advantages of standardization, without its disadvantages.

Rail Output Increases in 1934

RAIL production in the United States in 1934 totalled 1,010,224 tons, an increase of 593,928 tons, or 143 per cent, as compared with 1933, and 607,658 tons, or 151 per cent, as compared with 1932, according to figures released by the American Iron and Steel Institute. However, in spite of these increases, the tonnage for 1934 is still considerably below the level of rollings that prevailed in the years before the depression and compares with an output of 3,217,649 tons in the peak year of 1926, and of 2,722,138 tons in 1929.

The production of rails in 1934 was marked by an increase of 337,635 tons, or 220 per cent, in the output of rails weighing 100 lb. and less than 120 lb. per yd., although those weighing 120 lb. per yd, and over showed an increase of 200,960 tons, or 128 per cent. Together, the increase in these classifications accounted for 538,595 tons, or 91 per cent, of the total increase of 593,928 tons. A new feature inaugurated with this years compilation is the segregation of the tonnage of rails weighing 136 lb. per yd. and over into a separate column in the table showing the production of rails by weights, this figure for 1934 amounting to 31,805 tons.

The production of rails rolled from

Production of Rails by Weights Per Yard, Gross Tons, 1920-1934

Year	Under 50 pounds	50 and less than 85	85 and less than 100	100 and less than 120	120 and less than 136	136 and over	Total
1920	489,043	433,333	952,622	729,118			2,604,116
1921	211,568	214,936	902,748	849,566			2,178,818
1922	265,541	274,731	728,604	902,900			2,171,776
1923	272,794	300,907	864,965	1,465,850			2,904,516
1924	191,046	213,274	853,431	1,175,581			2,433,332
1925	163,607	219,648	765,371	1,636,631			2,785,257
1926	197,260	256,287	797,662	1,966,440			3,217,649
1927	161,836	173,257	539,445	1,314,421	617,524		2,806,486
1928	134,197	125,726	465,393	1,203,749	718,428		2,647,493
1929	141,362	102,944	409,628	1,233,599	834,605		2,722,138
1930	95,626	81,299	267,879	835,496	592,933		1,873,233
1931	50,089	25,524	123,398	495,752	462,988		1,157,751
1932	16,655	13,705	28,593	215,091	128,522		402,566
1933	*49,116	†15,413	40,973	154,007	156,787		416,296
1934	*70,085	†17,111	73,639	491,642	325,942	31,805	1,010,224

*Under 60 pounds per yard. †60 and less than 85 pounds per yard.

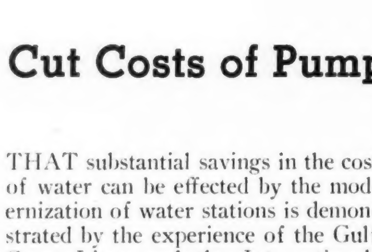
Production of Rails by Processes, Gross Tons, 1920-1934

Year	Open-Hearth: Rolled from ingots	Open-Hearth: Rolled from new seconds, etc.	Bessemer and Electric	Rolled from old rails	Total	Included In Total: Girder and H tee	Included In Total: Alloy
1920	2,312,750	21,472	143,196	126,698	2,604,116	100,910	12,909
1921	2,019,988	7,227	55,564	96,039	2,178,818	89,162	6,276
1922	2,032,004	996	22,317	116,459	2,171,776	128,878	3,163
1923	2,721,578	17,201	25,995	139,742	2,904,516	130,056	2,142
1924	2,295,755	11,778	16,069	109,730	2,433,332	85,533	5,167
1925	2,678,536	13,287	9,687	83,747	2,785,257	98,620	4,009
1926	3,098,776	9,216	12,533	97,124	3,217,649	116,374	4,216
1927	2,712,287	5,578	1,566	87,055	2,806,486	99,621	1,265
1928	2,573,608	6,533	3,156	64,196	2,647,493	113,150	6,453
1929	2,651,397	10,766	4,209	55,766	2,722,138	109,678	1,965
1930	1,829,143	5,790	2,182	36,118	1,873,233	69,814	4,687
1931	1,132,433	3,118	828	21,372	1,157,751	44,652	533
1932	390,816	2,198	64	9,488	402,566	29,003	565
1933	388,420	9,372	300	18,204	416,296	17,561	437
1934	970,428	11,645	2,032	26,119	1,010,224	29,988	1,598

old rails amounted to 26,119 tons as compared with 18,204 tons in 1933, while the combined output of Bessemer and electric rails totalled 2,032 tons as against 300 tons in the previous year. A substantial increase also took place in the quantity of alloy-treated rails produced, the amount being 1,598 tons in 1934, as compared with 437 tons in 1933.

Cut Costs of Pumping Water

THAT substantial savings in the cost of water can be effected by the modernization of water stations is demonstrated by the experience of the Gulf Coast Lines and the International-Great Northern, units of the Missouri Pacific Lines, which have modernized a total of 14 water stations during the last several years and which, by reason of the more up-to-date equipment that has been installed, have reduced the average cost



View of the $1\frac{1}{2}$-In., 5-Hp. Centrifugal Pump Installed on a Floating Platform at Jacksonville, Tex.

of water delivered at these 14 stations from 7.16 cents to 2.49 cents per thousand gallons, these costs including labor, fuel, lubricants and repairs but excluding interest and depreciation. The saving in wages alone amounts to $850 monthly.

Prior to the modernization program, the equipment at these 14 stations embraced either steam, gasoline or oil-engine-operated units, all of which required manual attendance. These plants now embody automatically controlled, electrically operated pumping units comprising either centrifugal or deep-set turbine pumps, the installation of which involved a total cash expenditure of $19,690, of which $3,090 was chargeable to capital account.

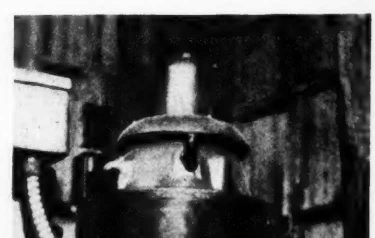
All manual attention required by the 14 modernized plants is supplied by the equivalent of two men on full time. In some cases the necessary attention is given the pumping equipment by the water-service repairmen during their periodic trips over their districts, while in other cases this work is handled by signal maintainers.

In making the new pumping installations, these railroads found it desirable to adhere to a policy of installing low-capacity pumps in conjunction with motors of low horsepower wherever large storage capacities were available. Not only do such installations have a low initial cost but they permit advantage to be taken of a more economical demand charge for power, in addition to affording more regular operation of the motors.

Duplicate Installations

At some of the more important stations, the installation of duplicate pumping units has been found desirable, these installations being so designed that either pump will handle the normal daily requirements of the plant. A swing switch is installed at such plants, so that only one of the pumps may be operated at a given time, thereby resulting in a considerable saving in the demand charge for current. The duplicate units are used alternately, the switch from one to the other being made about twice monthly. While such installations insure a constant supply of water, they also permit the delivery of water to be increased as much as 75 per cent above normal by cutting in both pumps, if necessary.

In connection with a number of the smaller pumping installations, it has been found feasible to obtain current from signal lines for the operation of the motors, thus taking advantage of an extremely low current rate. An



The New 4-In., 3-Hp. Turbine Pump at Huffman, Tex.

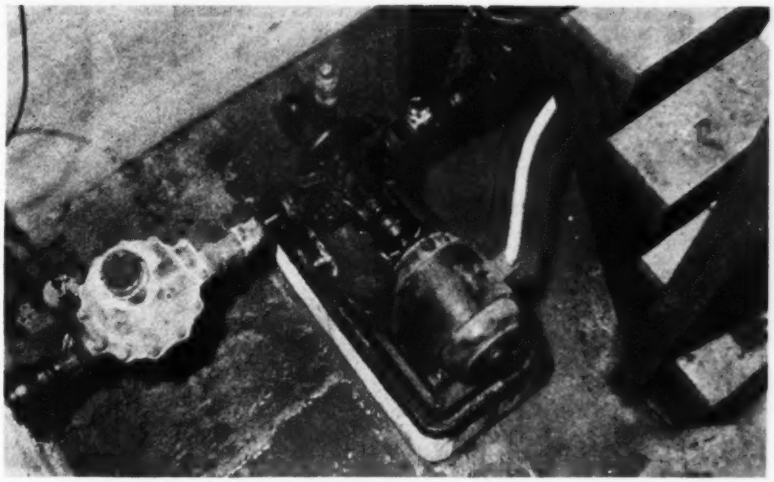
electric meter, indicating the number of kilowatt-hours of power consumption, is installed at each water station, the readings of which are used in determining the number of gallons of water pumped.

Typical examples of the manner in which the water stations were modernized follow:

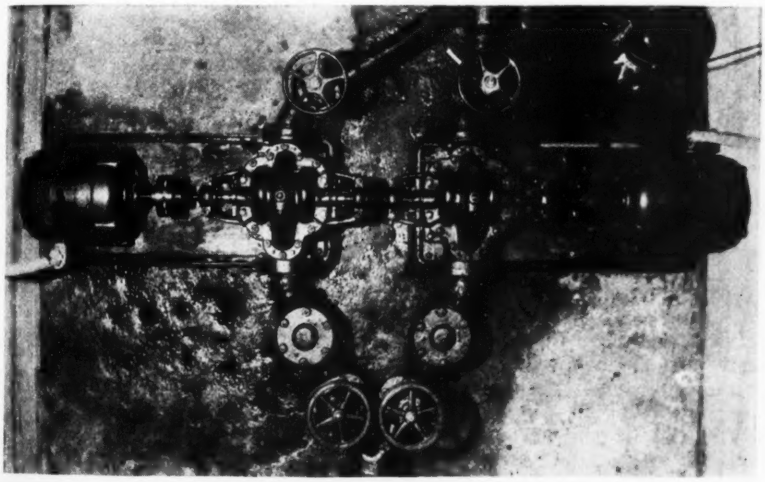
At Huffman, Tex., the old equipment, which required the services of a part-time pumper, consisted of a 5-hp. gasoline engine which operated a pump jack. The water pumped with this equipment cost 9.77 cents per 1,000 gal. The old plant was replaced with a 4-in. 3-hp. turbine which pumps 57 gal. per min. against a total head of 90 ft., the impellers being located 60 ft. below the surface of the ground. With this equipment the cost has been reduced to 5 cents per 1,000 gal. of water. The new plant uses 0.7 kw.-hr. of electric power per 1,000 gal. of water pumped.

At Jacksonville, Tex., water was formerly pumped by steam-operated equipment from a surface well, 28 ft. in diameter and 24 ft. deep. This plant was attended by a full-time operator and the water cost was 9.9 cents per 1,000 gal. The old equipment was replaced with a single 1½-in. 5-hp. centrifugal pump capable of delivering 117 g.p.m. under a total head of 62 ft. The new plant consumes 0.5 kw.-hr. of power per 1,000 gal. of water pumped at a cost of 1.3 cents per 1,000 gal. An unusual feature of the new layout is that the motor and pump are carried in the well on a floating platform, a flexible discharge line being used to compensate for variations in water level.

In a third plant, located at Spring, Tex., the original equipment consisted of a 10-hp. combination oil engine and pump. With a full-time pumper in attendance the cost of water from this plant was 9.5 cents per 1,000 gal. The new equipment consists of a single 1½-in. 3-hp. centrifugal unit which delivers 135 g.p.m. through a 5-in. discharge line, 400 ft. long, against a total head of 42 ft. This plant consumes 0.22 kw.-hr. per 1,000 gal. pumped, the power being obtained from a signal power line. As a result of the installation of the new equipment the water cost at this location has been reduced to 1.4 cents per 1,000 gal.



The 1½-In., 1½-Hp. Centrifugal Pumping Installation at Mercedes, Tex.



Looking Down on the New Centrifugal Duplicate Installation at Harlingen, Tex.

During the same period that this pumping-plant modernization program was being carried out, automatic electrically-operated pumping stations were also being constructed at eight points where water had previously been purchased from municipalities or from public utility companies. Whereas the cost of water at these eight stations formerly averaged 11.61 cents per 1,000 gal., it now costs 3.81 cents per 1,000 gal., exclusive of interest and depreciation but including electric power charges, repairs, lubrication, inspection and attendance. Computations based on the average consumption of water at the eight stations indicate that the new plants are saving the railroad a total of $740 monthly, or the equivalent of about 44 per cent annually on the investment of $20,200, all of which was chargeable to capital account.

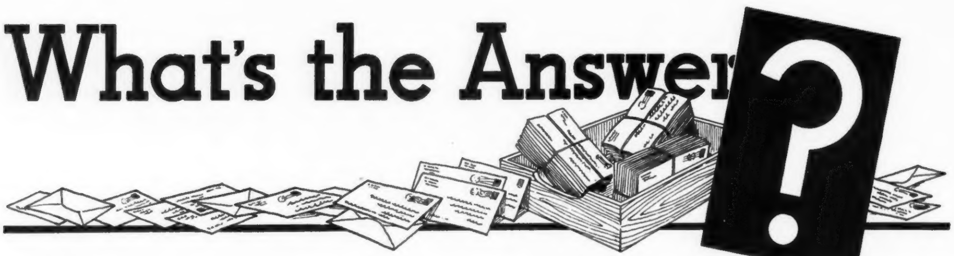
Brief descriptions of two typical pumping plants installed at points where water was formerly purchased are given below.

At Mercedes, Tex., where water was formerly obtained from the local power company at a rate of 13.5 cents per 1,000 gal., a single 1½-in. 1½-hp. centrifugal pump was installed to obtain water from a canal, through a 4-in. suction line 700 ft. long. This plant delivers 60 gal. per min. against a head of 42 ft. It consumes 0.26 kw.-hr. per 1,000 gal. of water pumped and the cost is 5.2 cents per 1,000 gal.

At San Marcos, Tex., where water was formerly purchased from the city at a cost of 9 cents per 1,000 gal., the railroad installed duplicate 1½-in. 2-hp. centrifugal pumps, each unit of which is capable of delivering 100 g.p.m. against a total head of 70 ft. This plant, which consumes 0.4 kw.-hr. per 1,000 gal., obtains water from the San Marcos river, delivery being made through a 6-in. line 1,200 ft. long. Water at this location is now costing the railroad an average of 1.4 cents per 1,000 gal.

We are indebted for the information presented here to F. S. Schwinn, assistant chief engineer of the Missouri Pacific Lines, Houston, Tex.

What's the Answer?



Can Gravel Ballast Be Cleaned?

Is it worth while to clean gravel ballast? If not, what means can be employed to overcome dirty ballast?

May Be Worth While

By A. N. Reece
Chief Engineer, Kansas City Southern, Kansas City, Mo.

If an adequate ballast section has already been provided, it is worth while to clean gravel ballast when it becomes foul. The cleaning should be done with a rotary screen having holes of such diameter that it will retain a large proportion of the small aggregate. Obviously, as is the case with other ballast materials, there will be a certain amount of material lost and sufficient new ballast will be required to restore the ballast section.

If the existing ballast section does not have the desired depth, it is more economical to raise the track on the old material. The cribs can then be filled and the shoulder formed with new gravel. At certain locations, such as railway crossings, street intersections, overpasses, etc., where it is impracticable or undesirable to make any change in the elevation of the track, it is desirable to clean the old ballast and add new material only as required to make up losses in volume.

Not Always Practicable

By District Engineer

Like many other questions relating to track maintenance, this one cannot be answered directly because there are varying basic conditions which must be taken into consideration. In the first place, gravel that is suitable for ballast generally contains a considerable percentage of fine material. On the other hand, stone containing an appreciable volume of fines is not fit for ballast, so that the cleaning of the two types cannot be compared.

Any practicable method of cleaning gravel in the field is certain to remove susbtantially all of the sand, leaving the cleaned product a mass of rounded pebbles, which have little of the stability necessary to remain under and support the ties. They may be excellent material to use on the shoulders, since they will afford almost, if not fully, as complete drainage as crushed stone, but there are practical difficulties in the way of keeping this material segregated for this purpose.

Some gravels which make excellent ballast, and many others which are inferior for this purpose but which are used because of their availability, have high percentage of fine material. In any attempt to clean these materials, only a small part of the original volume can be recovered, and a large part of the labor involved in the cleaning will be lost. On the other hand, many examples of washed gravel have a high content of sharp stones which have been sent through the crusher, for which reason they require only a small amount of the finer grades to act as a binder. In many cases gravel of this type can be cleaned to advantage, with a high recovery. Between these two extremes there is a multitude of gradations.

Again, the character of the constituent materials is important. In some cases the fines are coarse and sharp; in others they are small and water worn. Some of the sands are hard; others are soft, even to the point of friability. Some are naturally clean; others contain, in their natural state, appreciable amounts of silt or finely divided clay. Some gravels have a high percentage of small pebbles; in others the coarser material preponderates; while still others have comparable amounts of both large and small pebbles, with little gradation between them. These characteristics affect the practicability of cleaning gravel ballast, so that each case must be decided on its merits.

What is the alternative? Dirty gravel which cannot be cleaned is a useless material. By its very nature it is not suitable as a support for the ties and should never be used for raising the track. In the long run, it is far more economical to discard it and use new gravel for tamping the ties, as well as for filling

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions you wish to have discussed.

To Be Answered in August

1. *Is it more difficult to line track that is newly surfaced or track that has not been raised? Why? Which will hold the line better? Why?*
2. *Are pipe coils or cast iron radiators more effective for heating engine-houses and shops? Why?*
3. *Is there a definite relation between the diameter of track bolts and the proper length of the wrench? Why? If so, what is this relation?*
4. *Where a concrete arch or box culvert replaces a steel span or timber trestle, what method should preferably be followed in filling over the structure? Why?*
5. *When laying rail having the same base as the old rail, should new tie plates be applied with the new rail? Under what conditions?*
6. *What action is necessary to prevent the suction being broken in small streams during periods of low water?*
7. *How does one adjust the throw of a switch stand? What precautions should be observed?*
8. *Why are new steel surfaces cleaned before painting? How should the cleaning be done to secure best results? In what ways do the methods differ from those employed on surfaces that have previously been painted?*

the cribs and forming the shoulder. If this is not done, churning track is certain to result in a comparatively short time, depending on the amount of rainfall and the character of the roadbed.

It is not necessary that all of the value inherent in the material be lost in discarding the dirty gravel as ballast. If care is used in disposing of it, it can be used to level and widen the shoulder of the roadbed, and thus provide a support for the new ballast. In many cases this will eliminate the necessity for special methods of bank widening and thus go a long way toward paying for the extra cost of the new gravel.

Base Plates on Spring Frogs

Is there any advantage in fastening base plates to spring frogs? If so, is it better to weld or rivet them? Why?

Welded Plate an Advantage

By George J. Slibeck
Sales Engineer, Pettibone Mulliken Company, Chicago

Base plates under the movable rail of a spring frog include both plain slide plates for the movable rail to slide on and plates with either stop braces, auxiliary springs or hold-downs fastened to them, which also act as slide plates. The stop braces, auxiliary springs and hold-downs must be at fixed distances for the movable rail to move to when it opens up to let wheels through. These fixed points must be maintained, and the only way to do this is either to weld or rivet these particular plates to one side of the frog. The plain slide plates should also be fastened to one side of the frog. They can be left loose if desired, but I prefer to have them fastened because it helps in spacing the ties and also assures that there will be no loss of the plates during shipment.

From long experience I have reached the conclusion that a welded plate is of advantage, as compared with a riveted plate, for the reason that it is impossible to get enough stock in the riveted plate to rivet to, especially when countersunk heads are used. This means that the rivets get loose sooner or later, and if not taken care of, they may result in trouble.

Some roads use a cone head under the plate which gives the rivet a chance to hold, while the cone heads sink into the ties and act as anti-creepers.

Where welding is resorted to, it will be unnecessary to drill holes in the base of the rail. However, I have never seen or heard of any rail breaking as a result of these holes. While the A.R.E.A. plans do not provide for any welding of the rail in frog construction, I believe that this is bound to come, not only with respect to the welding of the plates but also to all of the other appurtenances of frog construction.

They Must Be Fastened

By Supervisor of Track

This is a matter which I have been considering for some time. The question is a timely one. It is not a matter of opinion that certain of the base plates should be fastened rigidly to the frog. The stops, hold-downs and springs which determine the travel of the spring rail are fastened to base plates and their position must be fixed relative to this rail. This can be accomplished only by fastening the plates which carry them rigidly to the frog.

In addition to these plates which must be maintained in a fixed position with respect to the wing rail, there are several plain slide plates. While there is no fundamental necessity for fastening them to the frog, I like to have this done. The A.R.E.A. standards call for a certain tie spacing and the maintenance of this spacing is assured if all of the plates are fastened at the specified distances apart.

I have never been satisfied with rivets as a means of fastening the plates, since they tend to get loose and, if not replaced, not a few of them break or pull through the plates, especially where the heads are countersunk. This led me to try welding in an experimental way. Three partly worn frogs in which the rivets were loose were chosen. The rivets were cut out and the plates welded. The frogs were then installed in yard tracks where they are subject to a large number of low speed movements through both routes. Incidentally, these locations, while not suitable for spring frogs, offered an excellent opportunity to run this test. While they have been in service only a short time, the results so far are satisfactory and I am convinced that welding is superior to riveting.

Round Versus Flat Brushes

Is a round or a flat brush preferable for painting steel bridges? For painting wood surfaces? Why?

Uses Three Styles

By Herbert J. Cunniff
General Painter Foreman, Delaware & Hudson, Green Island, N. Y.

When using a paint brush, one should always select a type that will insure the best quality of work and at the same time the greatest production consistent with this requirement. I find three different styles of brushes appropriate for painting steel bridges. First, we use what is known as the 7/0 oval brush, this being 2½ in. wide and 2 in. thick, with bristles 5 in. long. This brush may appear to be a trifle heavy for some men, but after they become accustomed to using it, they find that, by keeping it well stocked with paint, it becomes an easy matter to swing it around rivet heads and cover them with one swing of the brush. When well stocked with paint, this brush will cover one square yard of flat, smooth steel surface.

We also find the style known as the 1/0 roof brush very useful. This brush, which is fitted with a handle about 5 or 6 ft. long, is used to reach inaccessible places, such as the interior of the intersection between the top chord and the end post, the intersection of the end post with the bottom chord, and other places around truss bridges which it is practically impossible to reach with a short-handled brush. The third type which we find useful in painting steel bridges is known as the hatchet, or engine-cleaning, brush. This is used where there is not sufficient clearance to insert the ordinary types of brushes, as for example, the gusset connections around bridge seats, where some of the openings are little more than crevices.

For both the sidings of frame buildings and interior plastered walls, we

use a 4-in. flat wall brush, which we believe to be the most appropriate shape for this class of work. When kept well stocked with paint, it gives a satisfactory quality of work and a high production in the laying on of the paint. We do not use a perfectly round brush on any of our work. All of our paint and varnish brushes, except the flat brush just mentioned, are of the oval type. It is our experience that this shape has the widest spreading capacity for the paint.

Round Brush Best

By Master Painter

A round brush is probably the best for all-around work, and certainly is superior for painting steel surfaces. With a brush of this type, a skilled painter will spread and brush in paint better than can be done with any other shape. On the other hand, to obtain the best results, a round brush must be "bridled," or broken in, and an unskilled man cannot be relied on to do this properly. Since only a relatively few painters engaged in painting railway steel bridges can truly be placed in the "skilled" classification, we, in common with many other roads, have adopted the oval type of brush for this class of work.

We find that the oval brush gives very satisfactory results, from the standpoints of both quality of work and surface covered. It is important, however, that the foreman exercise constant vigilance to insure that the painters neither keep their brushes overloaded nor allow them to get dry. It is a basic requirement for good work on any painting job that the brush be kept well filled, but not overfilled with paint.

A round or oval brush is also adapted for painting wood surfaces, such as the exteriors of station and office buildings, although many painters prefer and apparently can do better work with a flat brush, the 4-in. width probably being best adapted for this class of painting. A round brush is almost indispensible for painting sash. Flat brushes are generally preferred for interior wall surfaces, particularly plaster walls, although the round brush in skilled hands is equal, if not better. The round type is the best for interior wood work.

A word concerning the quality of brushes may not be amiss, since an inferior brush cannot be expected to give good results, regardless of its shape. The best brush is made from bristles, of which several lengths are used. The shorter bristles are not merely fillers; they give the proper spring and stiffness to the brush and, as it wears down, they cause it to wear evenly and prevent it from becoming stubby. A good bristle has a perceptible taper and is split at the end. When inserted in a flame, it will curl but not burn, while imitation bristles burn readily. Not a few of the cheaper brushes are made of horse hair, which can be detected readily by the absence of taper and the fact that the ends are square, while such a brush has no spring.

How to Construct an Intake

How should one construct an intake in a small stream carrying a heavy load of silt?

Depends on Kind of Silt

By C. R. Knowles
Superintendent Water Service, Illinois Central, Chicago

In designing an intake, the type and construction will be governed in large degree by the character of the material carried by the water. This material is of two classes: (1) That having a specific gravity greater than water, including mud, sand, gravel, cinders, etc.; and (2) that having a specific gravity less than water, including fish, leaves, small sticks, etc. The term silt, as commonly used, includes many different materials, such as mud, clay, fine sand and certain forms of organic matter, so that it properly belongs in the first group.

Those materials included in the first group, because of their specific gravity, can be removed in whole or in part by providing settling basins of ample capacity. This is not always practicable, however, particularly with waters having high turbidity. For this reason, as a rule, the intakes are designed to avoid interruption to the water supply through accumulations of silt that might close the intake rather than with a view to its removal. Those materials included in the second group, which have a specific gravity less than water may be quite as objectionable as the heavier materials. They can be removed only by means of properly designed strainers.

A sump which has given satisfactory service in southern streams will be described, as the conditions encountered are quite like those implied in the question. This sump is constructed with two compartments, each having a floor area of about 50 sq. ft. The water enters the first compartment directly from the stream through an intake and comes to rest before passing into the second compartment. This arrangement permits the water to deposit a large part of its load in the first compartment, although it does not remain in this compartment long enough to complete the deposition of the finer particles of mud and silt. Screened openings of relatively large area permit the water to flow slowly into the second compartment, but hold back all floating matter, such as leaves, sticks, fish, etc.

The intake line from the stream to the first compartment should have a capacity not less than four times that of the suction line, so that the velocity of flow through this line should be much less than the suction velocity. It should be provided with a gate valve which can be closed while cleaning the sump, as it will be necessary to clean the deposit from the intake sump from time to time.

Silt Should Be Removed

By Supervisor of Water Service

Problems connected with obtaining water from a stream which carries a heavy load of silt always have been troublesome, but these difficulties have been increased by the continued demand for water of better quality. Under present standards, it is not enough to pump the water directly from the stream to the tank; it must be made as free from sediment as is economically practicable. This discussion relates, however, only to the facilities required to bring the water to the suction line.

While it is generally not economically feasible, and is in fact unnecessary, to clarify the water wholly before it reaches the pumps, all of the coarser and heavier sediment should be removed. The easiest and cheapest way to do this is to allow a period for sedimentation during which the velocity of flow is so reduced that the water is practically quiet. This can best be accomplished by providing a settling basin.

In general, the settling basin, which is part of the intake system, should be as close as practicable to the point at which the water is obtained from the stream, to shorten the inflow channel. The superficial dimensions should be such as to reduce the ve-

locity of flow to the point where the water will unload all but the finely divided matter, which matter may be held in suspension indefinitely. The depth should be sufficient to take care of the deposit for six months or a year.

Depending on conditions, the inflow channel may be open or submerged, that is, through a pipe. Where conditions permit, I prefer the open channel as it is accessible at all times. If it is constructed of creosoted timber or concrete, one or two vertical lift gates can be installed, the principal object of which is to reduce the accumulation of floating matter in the settling basin. This is accomplished by keeping the bottom of the gate submerged to the proper depth, especially during high water. In any event, the intake channel should be pointed down stream, as this will minimize the amount of floating debris which enters.

While the precautions which have been mentioned are sufficient in most cases to bar floating material from the settling basin, where they are not, a partition can be run across the basin and fitted with screened openings to strain out that which does enter. As a variation, the movable gates can sometimes be equipped with screens and thus kept closed, so that no debris will be drawn under them.

What Is Best Time to Kill Weeds?

Where weeds are destroyed by burning, chemicals or discing, at what stage in their growth are these methods most effective? Is this the same for all weeds? Why?

Considers Four Groups

By Division Engineer

For the purpose of this discussion, weeds may be divided into four main groups, namely annuals, winter annuals, biennials and perennials. Based on this grouping, it is apparent that to answer the question one must have knowledge of the habits of growth and methods of reproduction, as this is necessary to a determination of the stage in their growth at which destruction will be most effective.

As indicated by their name, annuals complete their growth in one year, that is, the seeds germinate in the spring or summer and the plants die in the fall. Most annuals produce a large qauntity of seeds which, in certain species, retain their vitality in the soil for many years. For these reasons, the most favorable time to destroy these weeds is while the seeds are germinating.

Winter annuals comprise only a small group of weeds which behave much like winter wheat, although in other respects some of them act as true annuals. In this group, under favorable conditions, the seeds usually germinate in the fall, continue their growth until cold weather, and complete it during the following spring. To eradicate weeds of this type, discing in the spring will be most effective.

Biennials require two years to complete their growth, behaving in this respect like some of the clovers, of which the red and sweet varieties are the most widely known. The seed is not produced until the second season, after which the plants die. Weeds of this class may be killed during the first year of their growth by cutting them off below the surface of the ground. Other methods of destruction which are effective give best results if applied during the first year.

Perennials are plants that produce roots, rooting stems or rootstocks which remain alive for several years. The primary functions of the rootstocks, as for example, in the Canadian thistle, is to store food for vegetative reproduction. It has been found that the food reserves of the roots of plants in this classs are usually lowest during the blossoming period and highest during the early winter and spring months. This means that top growth, after the seeds ripen, supplies food for storage in the root system. It is apparent, therefore, that the most effective stage for the destruction of these weeds will be that which prevents top growth from early summer until the end of the growing season.

Not the Same for All

By Assistant Engineer Maintenance of Way

Owing to the great variety of weeds which infest the roadbed and right of way; to the wide differences in their habits; to the tenacity with which many of them resist efforts to eradicate them; to the variation in the dates of their maturity; and to the wide differences in soil and climatic conditions throughout the country, it is impracticable to give a general answer to this question, while to take up each plant or family of plants in detail would require too much space for a discussion of this character. The nearest approach to a general statement that can be given is that weed destruction is most effective when accomplished prior to maturity of the seeds.

In most sections of the country the bulk of the weeds are annuals, the seeds of which germinate from early spring to midsummer. In many cases, the seeds of individual plants will be found germinating over an equal period. Most annuals produce a great number of seeds and, to avoid a heavy crop in succeeding years, it is important that the plants be destroyed not later than the blossoming time, particularly those producing seeds that can germinate within a few days after fertilization.

Since the period of initial growth extends over so long a period, it is not always possible to destroy all of the weeds at the most favorable time unless the weed-destroying operation is repeated during this period. Furthermore, the rate of growth and, therefore, the date of flowering differ with different plants, so that the most effective time for destroying one kind may not be the most favorable time for others.

Grasses belong to a class of plants, most of which are perennials, for which reason they may be very troublesome unless the roots are destroyed. Burning retards the growth but does not destroy some of the grasses. Even discing or scarifying is not fully effective unless it is followed up by pulling such plants as are not completely uprooted. Some of the weed-destroying chemicals destroy the roots as well as the tops. Whatever the method, however, it is wise to destroy the plants before they have seeded.

Among the most obnoxious and troublesome weeds are Johnson grass, Bermuda grass, Canadian thistles, bindweed, and others with running rootstocks in which they store food, or which send down roots at intervals along their stems. Many of these are perennials and by the very nature of their growth are not easily eradicated. The best way to eliminate them is persistently to destroy the top, thus compelling the plant to use its stored food to produce new growth. If this is done persistently and consistently, the entire food reserve will be used up eventually and the plant will die of starvation. Plants of these types should not be allowed to go to seed.

The foregoing list does not cover all of the weeds with which maintenance forces must contend. It does illustrate the fact that different weeds require different treatment and that the most favorable time for destroying one may be quite ineffective with another. For this reason, a compromise must be effected in the interest of practical weed destruction. To obtain the best results one should select the most undesirable weeds and accomplish their destruction at the proper time. If this is done, the character of the growth on the right of way may be completely changed, so that later it may be desirable to concentrate on one or more other classes of plant growths which have become predominant.

Salvaging Old Track Bolts

When relaying rail, is it practicable to attempt to salvage the old bolts? If so, are these bolts suitable for use with new rail? With released rail? Why?

Several Factors Involved

By H. T. Livingston
Division Engineer, Chicago, Rock Island & Pacific, Little Rock, Ark.

Several factors must be given consideration in the matter of salvaging bolts for reuse. Generally, bolts smaller than 1 in. have no salvage value, but must be classed as scrap. They can be removed more cheaply by breaking them with a sledge than by running the nuts off by either hand or power machine methods. The condition of the bolts at the time of removal depends on the maintenance they have received while in service, that is, whether they have been kept oiled and reasonably tight. Where the nuts are removed by power tools, both the bolts and the nuts suffer less damage than when this work is done by hand, so that a higher recovery is obtained. Where the bolts are broken with a sledge, the men doing this work should be spaced far enough apart to eliminate the possibility of personal injury from the flying nuts.

It is seldom that bolts, even those 1 in. or more in diameter, are suitable for reuse with new rail. If they are worth recovering, they are generally fit for use with the released rail when it is relaid. This will depend, however, on the class of track in which it will be relaid and the service to which it will be subjected.

When second-hand rail is relaid, it is classified and only the first-class material is relaid in main tracks. It is preferable, when relaying released rail, to use only new bolts, new spring washers and new angle bars. Bolts salvaged for reuse serve the purpose best if they are sorted carefully, oiled and stocked for reuse in the maintenance of secondary main tracks, branch-line main tracks and in yards.

A definite decision as to the disposition of the recovered material is impossible without a thorough knowledge of its condition and the use to which it has already been put. There must also be a similar knowledge of the use which is proposed for it and the probable cost of recovery.

Not with New Rail

By H. E. Herington
Section Foreman, Minneapolis & St. Louis, Jordan, Minn.

Only a little experience is required to show that the possibility of salvaging and reusing bolts recovered when laying rail, will depend largely on the kind of maintenance they have received. If they have been equipped with spring washers and have been oiled at suitable intervals, and the joints have been kept tight and in good surface, most of the released bolts should be suitable for further use. On the other hand, if maintenance has been neglected it is quite likely that most of the bolts will not classify better than scrap.

When laying new rail, only new bolts should be used. No matter how well the track and joints have been maintained, there will be more or less wear on the bolts, and it is axiomatic that when new material is assembled all parts should fit as nearly perfectly as is practicable. Wear reduces the size of the shoulder and the diameter of the bolt and, to some extent, cuts the threads. For these reasons an old bolt can never be made to fit properly, with the result that it will become loose and the new rail will be injured.

If released rail is to be relaid in secondary or branch-line main tracks, an extended service life is expected of it. It is possible to improve the condition of the rail and extend its service life in its new location by applying new angle bars and new bolts. On the other hand, any serviceable bolts which may be recovered when the rail is released can be used in yards and sidings where the service is not so exacting.

Yes, if Not Worn

By Robert White
Grand Trunk Western, Drayton Plains, Mich.

When relaying rail, an attempt should be made to salvage all bolts that are not too badly worn for future use. Released rail is generally used on some inferior track, and I fail to find any reason why the old bolts cannot be used again, always assuming that they have not become worn to or beyond the limit of usefulness. On the other hand, no bolt that has reached this limit or which has poor threads, should be used; it should be classed as scrap.

I do not approve of using old bolts with new rail. Where this is done it is generally necessary to replace many of them in a relatively short time. From my observation, I have reached the conclusion that where new and old bolts are mixed in the same joint, the tension is not the same when they are tightened, thus throwing unnecessary tension on the new bolts.

In many cases, if the salvaged bolts are not used with the released rail, they can be used to advantage in yard tracks and sidings. Like ties, one will always find bolts which have outlived their usefulness in the main tracks, but will give years of service in less important tracks.

Some Can Be Salvaged

By Supervisor of Track

It is desirable to salvage all materials which are suitable for reuse, and in some cases I have found it possible to recover a large percentage of the bolts from released rail. In others, the percentage of recovery is so low and the unit cost of doing so is so high that it is not economically feasible. As a general statement, it is rarely possible to salvage bolts of smaller diameter than 1 in. Rail requiring bolts of this diameter lacks the stiffness of the heavier sections and the depth of fishing is usually less, for which reasons there is usually considerable wear on the joint, including the bolts, so that few of them are worth saving.

While most of this lighter rail has disappeared from our important main lines, some of it is still in service and, although we have done what we could to keep it in good condition, in-

cluding the welding of the rail ends and the application of new angle bars and bolts, we still find that the bolts wear more rapidly than on the heavier rail. Where the bolts are practically new, we usually find it desirable to salvage them; the others are broken off with a sledge, as this is the cheapest method of removal.

If the joints have been well maintained and protected from corrosion, a large percentage of bolts 1 in. or more in diameter should be fit for recovery. Recently, I saw some 1⅛ in. bolts which had been removed after nine years of service on a relatively heavy traffic line, 90 per cent of which were still usable. In this case, in addition to good joint maintenance, the bolts had been kept oiled and the joints had been protected from brine drippings by applications of a heavy asphalt-base road oil.

Salvaged bolts should never be used with new rail because they are always worn to some extent, for which reason a tight fit cannot be secured. In some cases they can be reused with the released rail, but it is better to apply new joints and bolts when this rail is relaid. If they are worth salvaging, however, they can be used to advantage on yard leads, passing sidings and other important secondary tracks where rail and joints which they fit are in service. When applied in this manner, they may have additional service life comparable with new bolts.

When considering the recovery of bolts from released rail, it should be borne in mind that their condition will depend almost entirely on the character of the maintenance which the joint has received, and that a poorly maintained or badly worn joint seldom contains bolts that are in a fit condition to be salvaged.

Can Ballast Decks Be Justified?

What considerations justify the additional expense for ballast decks on steel bridges? On timber trestles?

Economics Not All

By H. S. Loeffler
Bridge Engineer, Great Northern, St. Paul, Minn.

In the last analysis, the type of deck that should be installed on any railway bridge will not depend on economic considerations alone, but also on the railway operating service requirements, and upon local conditions, as well as on requirements that must be met in the construction and maintenance of the structure. In general, however, the proper type of deck to be installed can be determined by economic analysis. Such an analysis should take into consideration the following items:

1. Annual interest on the original cost
2. Annual cost for maintenance
3. Annual installment to the sinking fund to provide for replacement at the end of its service life
4. Annual cost of fire protection

Item No. 4 should include the cost of fire insurance, watchmen's wages and other costs incidental to providing and maintaining fire prevention facilities that may be required in connection with non-fire-proof construction. In making these analyses, it is important that the item of increased first cost and the possible increased cost of maintenance by reason of the need for a heavier structure to support the weight of the ballast deck shall not be overlooked.

Further considerations, most of which cannot be reduced to an exact economic analysis, which favor the installation of ballast decks on both steel and timber bridges, are as follows:

1. Ballast decks provide smooth-riding track, thereby reducing vibration (impact) on the structure, as well as on the operating equipment. Coincidentally, a considerable amount of noise resulting from the passage of trains over the structure, is eliminated.

2. Ballast decks reduce the fire hazard, wherefore they reduce the hazard of traffic delays, for which no adequate insurance can be purchased.

3. It is sometimes necessary to provide waterproof construction for grade-separation bridges, and this can generally be secured more easily by installing a ballast deck. Waterproof construction provided in connection with a ballast deck gives added protection for the supporting structure, thereby reducing maintenance costs and increasing the life of the structure. This applies particularly to structures subject to brine drippings from refrigerator cars.

4. Where ballast decks are installed on curves, it is simple and easy to make adjustments later in the superelevation.

5. Ballast decks require renewal at longer intervals than open decks, which effects a reduction in the overall delay to traffic as a result of maintenance operations. This is a consideration that may be of considerable importance on a line of dense traffic or a large volume of high-speed traffic.

Have Many Advantages

By S. F. Grear
Assistant Engineer of Bridges, Illinois Central, Chicago

Ballast decks on steel bridges can be justified economically only for certain locations and under certain conditions. They must be justified on the grounds of necessity and desirability, rather than on the basis of economics, although they do result in considerable saving in maintenance expenses. For these reasons, the economics of ballast and open-type decks will not de discussed, but only the advantages, from the operating and maintenance standpoints, of ballast decks, as compared with open decks, will be mentioned. Among these are the following:

1. Ballast decks greatly reduce the fire hazard and the possible damage resulting from fires.

2. They reduce track maintenance, since the track can be kept in line and surface by the regular section forces. This eliminates the necessity for moving bridge gangs, sometimes for considerable distances, to do this work.

3. Damage resulting from derailments is generally less severe on track ties than on bridge ties, while the latter are far more expensive. Furthermore, the bridge ties may not be immediately available for replacement when a derailment occurs.

4. Ties are always subject to damage by respiking, cutting by tie plates and other forms of mechanical destruction, and track ties are cheaper and cost less to renew than bridge ties.

5. In general, the track on a ballast deck rides more smoothly.

6. Probably the greatest advantage of the ballast deck on steel bridges is the fact that it provides an opportunity to protect the steel from brine drippings. On lines carrying a heavy refrigerator traffic in connection with which salt is used, the deterioration due to brine drippings results in a considerable loss from corrosion, if the steel is not protected.

7. A solid floor is essential for bridges spanning streets and important highways, to prevent water, coal and other objects from dropping

through the floor of the bridge. From my own experience, I have reached the conclusion that the only satisfactory solid floor is the ballast type. In former years, many designs of solid floors have been developed, including floors of plates with the rails bolted to them, but these only resulted in continual maintenance troubles.

8. Much of the noise of passing trains is eliminated through the use of ballast decks on steel bridges, this feature being particularly important in towns and cities. This type of floor is particularly helpful in lessening the noise on deep through plate girders.

On timber trestles, the ballast deck is of still more importance than on steel spans. The foregoing statements from 1 to 5, inclusive, apply to timber trestles as well as to steel spans. In addition to these advantages, which are common to both types of structures, the ballast deck on a timber trestle has a distinct advantage in case any settlement or side movement occurs in one or more bents, since the track can be surfaced and lined without disturbing the timber in either the bents or deck.

Replacing Floors in Stations

How does one go about the replacement of sills, joists and floors of a small combination station when both the passenger and freight facilities must be kept in service?

Selects Slack Season

By A. L. Becker
Architect, Missouri Pacific Lines, Houston, Tex.

As a rule, the business at stations of the kind implied in the question is seasonal, for which reason we arrange our maintenance porgram in such a way that, except for emergency cases, all station repairs will be made during the slack season. As the ebb of business does not occur simultaneously on all parts of the system, we find it possible to spread the volume of work, as well as the cost, over the entire year. This offers an opportunity to exercise closer supervision than if the building work on the entire system is done in the short period ordinarily considered as the working season for such work.

In work of the kind under discussion, the procedure varies with the extent of the repairs involved. If all of the sills and only occasional joists are to be replaced, second-hand stringers are placed under the joists so that the entire structure can be jacked up about one inch, or far enough to relieve the sills of their load. The old sills are then removed and new ones are inserted without difficulty. The stringers are laid so that they will be continuous from one end of the building to the other, except that where bad joists occur a small gap is left between the ends of the stringers to facilitate the replacement of these joists. After the sills and joists have been replaced, the building is lowered onto the foundation, the entire operation being so conducted that it does not interfere with either the passenger or freight service.

In those cases where the replacement of all of the sills, joists and flooring is involved, the station, is jacked up in the manner already described and the sills are renewed. It is a relatively simple matter to do this without serious interference with the business of the station. The building is then lowered onto the foundation, so that the remainder of the repairs can be made. These repairs, consisting of the replacement of the joists and flooring, are generally made over small sections of the floor area, beginning at one end of the station and progressing toward the other. In this way, the floors can be renewed with the minimum interference with the operation of the several facilities.

Works Progressively

By E. R. Tattershall
Supervisor of Structures, New York Central, New York

A plan which has often been followed is to take care of the sill replacements first, at which time it may be found that it will also be necessary to replace part of the studding. In this case, it will be necessary to remove some of the siding and sheeting from the outside of the building. It may also be necessary to provide some intermediate supports through the wall to permit the removal of a sufficient length of the sill.

After this part of the operation has been completed, the usual practice is to limit the floor space in the office, waiting room or freight room to a smaller area than is normally in use, and to replace the joists and subfloor in the temporarily abandoned section. Other sections are then cared for progressively until the renewal is completed, after which the finished floor is placed. In carrying out this part of the program it may be necessary to construct temporary runways through the doorways and, perhaps, to the ticket window.

It cannot be denied that some inconvenience will be caused to passengers during the progress of the work in the waiting room, but I have found that they understand the necessity for the work and, if the proper effort is made to minimize this inconvenience, they are willing to go along good-naturedly with the procedure.

May Work from Outside

By A. Finnes
Master Carpenter, Great Northern Minot, N.D.

To a certain extent the method to be followed will depend on local conditions. Where the building sets well above the ground, jacks can be placed under the joists, just inside the sill, and the building raised high enough to clear the sills. This will permit the old sills to be removed and the new ones to be inserted. The building can then be lowered into place. This part of the work can be carried out without disturbing the station platform or interrupting service.

The next move is to take up a section of the floor, then set a track jack on the new sill and raise the walls enough to clear the ends of the joists, removing the old joists and inserting new ones where the floor is open. The wall should then be lowered and a temporary floor placed over the new joists, to facilitate the handling of the station business while the work is under way. This can be done progressively, section by section, until one room is completed, when the permanent floor should be laid and the room returned to full service. This same method can be repeated room by room, reusing the material for the temporary floor, until the entire job is finished.

If the building sets close to the ground, it may be difficult or impracticable to get under the floor, in which case it will be necessary to handle the renewal of the sills from the outside of the building. This will, in turn, require removal of part of the station platform to make room for the old and new sills, as they come out and go into place. The remainder of the work can be carried out in the same manner as described.

New and Improved Devices

A New Type of Electric Tie Tamper

THE Chicago Pneumatic Tool Company, New York, has supplemented its line of straight pneumatic tie tampers with a new electrically-driven but air-impact tie tamper, which has been given the trade name, Hicycle. This new tamper compresses the air within the tool itself, and the air thus compressed drives the tamping bar in much the same manner as the straight air tool supplied with compressed air from an outside course. The tool delivers approximately 1,500 blows per minute, each blow having a force of from 7 to 8 ft. lb. It is said that the tool has a minimum of vibration and that the blows have a follow-through effect which assists in forcing the ballast beneath the ties with a minimum tendency to shatter it.

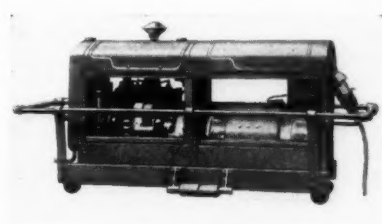
The Hicycle Tie Tamper

Essentially, the new tamper includes an electric motor at the upper end, a drive arrangement including spiral bevel gears and a drive crank, a compression chamber immediately below the driving mechanism, housing a compression piston, and a striking piston, which impinges directly upon the tamping bar. The motor, which is of the squirrel-cage induction type, wound for 180 cycles, 3 phase, 115 volts, operates the crank through the bevel gears, which, in turn, drives a reciprocating cylinder, so constructed as to form a part of a variable volume compression chamber in which air is alternately compressed and rarified.

A straight cylindrical striking or hammer piston slides in an extension of the reciprocating cylinder, and is driven forward by compressed air admitted through ports in the cylinder wall. These ports are arranged to delay admission of air behind the striking piston until almost full compression has taken place in the compression chamber. Thus, full force of the compressed air is released suddenly to the striking piston, to drive it forward to a blow on the tamping bar.

It is said that at the end of the normal stroke of the hammer piston, there is still considerable pressure remaining on the piston to force it further forward against the tamping bar, producing a follow through effect on the impact on the ballast. At the end of the stroke of the hammer piston, exhaust ports allow the air in the system to exhaust to atmospheric pressure.

When the compressor piston starts on its upward stroke, the air back of the hammer piston is rarified, which has a tendency to draw this piston automatically into its upward position. When the compressor piston reaches the top of its stroke, ports are opened to take in a fresh charge of air and restore the system to atmospheric pressure, ready for another stroke.



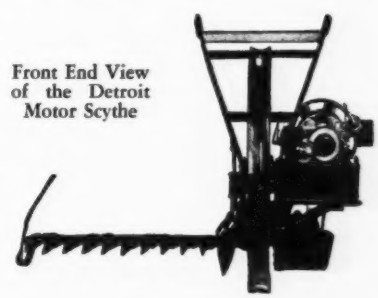
One of the Portable Electric Power Units Designed for Operating Hicycle Tie Tampers

All operating parts of the tamper are lubricated from within from a filling of engine oil in the gear and crank compartment, and a counterweight on the crankshaft has been provided to compensate for the unbalance of the reciprocating parts.

For operating the new tampers, the company is furnishing portable electric power generating units in sizes capable of operating 4, 8 and 12 tools. These units include essentially a 110-volt, 3-phase, 180-cycle generating unit, direct-connected to a standard Hercules four-cycle gasoline engine. The entire unit is mounted on a common base and is enclosed by a metal housing with removable side covers.

New Motor Scythe

The Detroit Harvester Company, Detroit, Mich., is marketing a motor-operated scythe, known as the Detroit motor scythe, which consists of a welded and riveted pressed-steel frame carrying a one-cylinder gasoline motor and a 36-in. sickle, which is mounted on a 30-in. wheel having a 3-in. concave tread. Handles are provided for guiding and propelling the machine wheelbarrow fashion.



Front End View of the Detroit Motor Scythe

The sickle is driven from the air-cooled ¾-hp. engine by means of a V-belt from the crankshaft to the countershaft and thence by means of a pitman rod. Lubrication of the engine is obtained by mixing ½ pt. of lubricating oil with each gallon of gasoline. The gasoline tank, which has a capacity of ½ gal., is made of heavy sheet steel and is welded to the frame in such a manner as to form a base for the engine. The total weight of the scythe is 160 lb., while the operating or lift weight at the handles is 15 lb.

One of the advantages claimed for this scythe is that the wheel runs independently of the sickle, allowing the unit to be backed up or tilted for cutting up or down slopes. This

scythe is said to be adaptable to all kinds of weed and grass mowing. By slowing down the rate of propulsion, the sickle is said to act much like a saw in cutting its way through heavy growths of weeds, grass or brush.

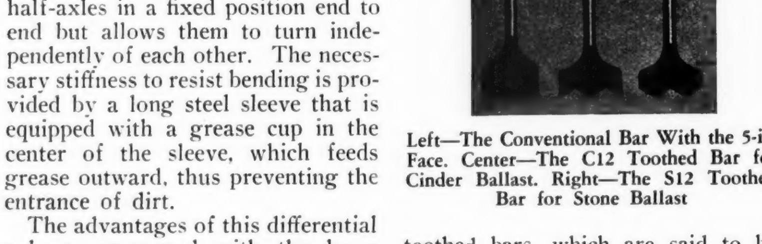
Fairmont Develops Differential Axle

FAIRMONT Railway Motors, Inc., Fairmont, Minn., has developed a new axle assembly that provides for differential action of the two wheels in operation around curves and in turning the car, when placing it on or taking it off the track, that is said to embody a number of advantages over the usual loose-wheel arrangement.

This differential axle, which is applied at the end of the car opposite the drive axle, is made up of two pieces, each having a tight fit on the wheel on its respective side of the car and connected midway between the wheels by a special assembly. This assembly consists of a two-piece bronze coupling that holds the two half-axles in a fixed position end to end but allows them to turn independently of each other. The necessary stiffness to resist bending is provided by a long steel sleeve that is equipped with a grease cup in the center of the sleeve, which feeds grease outward, thus preventing the entrance of dirt.

The advantages of this differential axle as compared with the loose wheel, are founded on the fact that the coupling is introduced into the two-axle assembly at the point where the required bending resistance is least, namely, midway between the journal bearings. For this reason and because of the length of the sleeve provided, the bearing pressure per square inch for a given load per axle is only about one fifteenth of that applied to the bushing of a loose-wheel. For these reasons it is claimed by the manufacturer that the differential axle will be subject to less wear and will give longer life than the loose-wheel assembly.

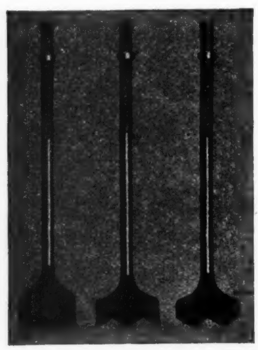
The new axles are now standard for heavy-duty Fairmont motor cars, and are made in $1\frac{7}{16}$ in., $1\frac{11}{16}$ in., $1\frac{7}{8}$ in., and $1\frac{15}{16}$ in. sizes. They are recommended for use on any heavy-duty car where the maintenance of the loose-wheel has been found expensive and difficult to check as often as safety requires.



Above—The Fairmont Differential Axle. Below—View of a Dismantled Axle Showing the Type of Bronze Coupling Used.

I-R Toothed Tamping Bars

THE Ingersoll-Rand Company, New York, has brought out two toothed tamping bars for use with its pneumatic tie tampers, the use of which is said to result in a marked increase in the work done per tamper. These



Left—The Conventional Bar With the 5-in. Face. Center—The C12 Toothed Bar for Cinder Ballast. Right—The S12 Toothed Bar for Stone Ballast

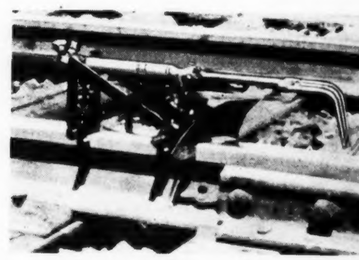
toothed bars, which are said to be most effective where the track is being tamped out-of-face with a lift of one-inch or more, are made in two types, one for cinders, gravel and fine crushed ballast and the other for stone ballast.

The toothed bar for fine ballast, which is known as C12, has a $\frac{3}{4}$-in. by 5-in. face and two V-shaped notches. The increased effectiveness of this toothed bar is said to be due to the fact that the notches retain the ballast under the tamping bar instead of allowing it to escape along the edges. The toothed bar for stone ballast, which is known as S12, has one V-shaped notch between two teeth of similar shape. The face of this bar is $\frac{5}{8}$ in. by 5 in.

The Ingersoll-Rand Company has also brought out another tamping bar of conventional shape except that the face has been widened from 3 in. to 5 in. in order to increase the effectiveness of the tool when used in cinder and other fine ballasts.

Three-Flame Welding Tip

OUT of the experience of the Pennsylvania in building up battered rail ends by the oxy-acetylene process, there has been developed a three-flame welding tip, with a special carriage mounting, designed specifically for rail end welding work. This combination is said to offer advantages over the ordinary hand use of the single-flame torch, both as regards the character of the welds produced and the speed and economy



Side View of the Three-Flame Tip Mounted in the Carriage Developed For Rail-End Welding

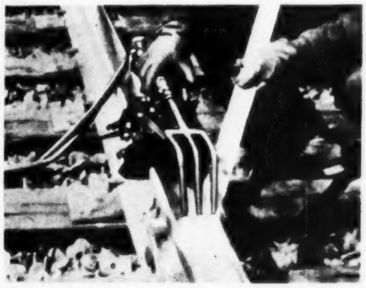
with which the work is done. The purpose behind the development of the multi-flame tip was not alone to speed up the work of building up battered rail ends, but also to provide a means for shortening the period of heat application and thereby confining the welding heat as much as possible to the surface of the rail head.

In its endeavor to secure this result, the Pennsylvania first produced a two-flame welding tip, which consists essentially of two single tips placed side by side and fed from a common gas-distributing chamber. The two-flame tip, which was described in *Railway Engineering and Maintenance* for March, 1934, has been used with a welding rod $\frac{1}{8}$ in. thick by $\frac{3}{4}$ in. wide and 36 in. long, worked on the flat side. This combination approached the result desired of minimized heat penetration of the rail head, and reduced the time of the complete welding operation approximately one-half. The advan-

tages found in the two-flame tip suggested the development of a three-flame tip and a suitable carriage to insure the continuous manipulation of the torch at the most effective distance from the rail head surface, to insure maximum heat utilization with a uniform minimum heat penetration of the head.

In the three-flame tip, the individual welding tips are set a pre-determined distance apart on extended radial lines of the rail head curvature, this distance depending upon the width of the rail head and the size of the tips. Thus, the centers of the flames of the individual tips contact the curved surface of the rail head perpendicular to the tangent to the curve at the point of contact, with the result that a maximum of heat is applied, and very little is lost into the atmosphere by deflection or refraction.

The three-flame tip is used with a standard oversize torch, and is manipulated in much the same manner as the single-flame or two-flame torch. However, in view of the fact that the three-flame arrangement spreads the heat simultaneously across the full width of the rail head, there is less cross movement of the torch while welding than is common when the single or two-flame tip is used. The Pennsylvania uses a flat welding



Building Up Battered Rail Ends With the Three-Flame Torch and Carriage Assembly—Note the Wide Flat Welding Rod Employed

rod, 1/8 in. thick by 1 5/8 in. wide, with the three-flame tip for rail end welding, which also requires that there be less lateral movement of the tip during the welding operation. As the surface of the rail head is brought to welding heat, the welding rod material is flowed on evenly and to the desired thickness. This is accomplished by moving the torch backward and forward, and sidewise as necessary, simultaneously with a general backward movement as the weld is completed. To secure the full efficiency of the three-flame tip, it is necessary that it be fed by a battery of three cylinders of acetylene and one of oxygen. This holds the required pressure in the acetylene, and results in the more complete exhaustion of the acetylene from the cylinders.

To insure uniform application of the heat, which it was felt was particularly desirable in view of the increased volume of heat emitted from the three-flame tip, a carriage was developed to mount the torch rigidly, with the tips at the proper distance from the surface of the rail head. This carriage, which is constructed of light steel shapes, about 18 in. in length by 8 in. over-all width and 7 in. high, is mounted on a concave surface roller at each end so that it can be moved by hand back and forth longitudinally on the rail head.

The welding torch is mounted directly on top of the carriage, the front end of the handle being fixed rigidly to a bracket, whose fastening to the carriage frame is sufficiently loose to allow movement of the torch in a vertical plane about the bracket as a pivot. The rear or gas inlet end of the torch handle is held by a second bracket at the rear of the carriage, the position of which can be raised or lowered by means of a double-end knurled adjusting screw. Thus, by a simple adjustment of the screw, the welding tips can be set at the desired distance from the surface of the rail head.

At the bottom of the carriage on each side there are two rollers, one forward and the other to the rear, which press against the sides of the rail head and keep the carriage in position on top of the rail. On one side the rollers are attached rigidly to the carriage, while on the opposite side they are attached to a swing apron, and are normally held in place tightly against the side of the rail head by a spring. A thumb projection on the apron makes it possible to relieve the clamping action of the rollers, so that the rear of the carriage can be moved laterally across the rail to produce a corresponding lateral movement of the tips with respect to the rail head.

Two steel shields of suitable shape and size are mounted on the front of the torch carriage to protect the welder from heat from the flames. The welder kneels along one side of the carriage and feeds the welding rod from the rear, diagonally into the flames. Thus, the hottest points of the flames are kept just ahead of the rod, affording the necessary pre-heating of the head metal in advance of making the actual weld.

Experience with the three-flame torch and carriage on the Pennsylvania has demonstrated that the combination is producing the desired results. Thus, it is said that the time of making rail end welds has been reduced to less than half that required with the single-flame torch; that the depth of heat penetration into the head had been more than cut in half, not exceeding 1/2 in. with proper manipulation; and that fusion is even

The Three-Flame Tip as Finally Developed with a Tip Spacing Block and a Gas Distributing Chamber

and a homogeneous deposit is secured throughout the weld area. In addition, a saving in gas is indicated.

Both the two and three-flame tips and the torch carriage for use in rail end welding were developed by J. G. Hartley, assistant engineer on the Pennsylvania, with the co-operation of the Air Reduction Company, New York, which is handling the manufacture and sale of the tips.

New Book

Roadmasters' Proceedings

PROCEEDINGS of the Roadmasters' and Maintenance of Way Association for 1934, 208 pages, 6½ in. by 9¾ in. Bound in cloth. Published by the Association, 428 Mansion street, Pittsburgh, Pa.

The appearance of this volume records the restoration of the activities of this organization after an enforced suspension of its conventions following the convention in 1930. However, it is apparent from the contents of the new volume, that it renewed its activities in full at its meeting at Chicago last September. As in past years, the convention program included five committee reports and several papers and addresses. The subject-matter of the reports covered Tie Renewals, Embankment Maintenance, Rail Conservation, Highway Crossing Construction, and the Cleaning of Stone Ballast; while the papers included the New Goal in Safety, by J. E. Long, superintendent of safety, Delaware & Hudson; Building a Maintenance Organization, by A. N. Reece, chief engineer, Kansas City Southern; Permanent Track Construction, by Robert Faries, assistant chief engineer—maintenance, Pennsylvania; and Meeting Present-Day Requirements, by Earl Stimson, chief engineer maintenance, Baltimore & Ohio.

News of the Month . . .

New Haven Buys Trucks for Roadway Department

In connection with a reorganization of its track forces, involving the lengthening of sections, and to a large extent, the substitution of sizable extra gangs for regular section gangs, the New York, New Haven & Hartford has purchased 51 Dodge and International highway motor trucks for the use of the extra gangs to facilitate their movement from place to place where work is required. The trucks, manufactured by the Chrysler Corporation and the International Harvester Company, have a maximum capacity of 6,000 lb. and are of two general types, one type having a fixed canopy top with roll-down sides, and the other having a rack body with removable sides, top bows and tarpaulins. Thirty-five of the trucks have 15-ft. bodies and a wheelbase of 190 in., while the remainder have 12-ft. bodies and wheelbases of either 161 in. or 175 in.

Railroads Increase Purchases in 1934

The Class I railroads of the United States spent $600,224,000 for materials and supplies and fuel in 1934, an increase of $134,374,000, or 29 per cent, as compared with 1933, according to figures compiled by the Bureau of Railway Economics of the Association of American Railroads. Amounts expended for individual items included $31,107,000 for new and second-hand steel rails, as compared with $11,835,000 in 1933; $31,283,000 for track materials, such as bolts, spikes, tie plates, rail anchors, frogs, switches and crossings, as against $16,691,000 in 1933; $35,605,000 for crossties, as compared with $21,746,000; and $4,340,000 for switch and bridge ties as compared with $2,901,000. Expenditures for fuel in 1934 amounted to $217,294,000, an increase of $36,768,000 over 1933. The increased expenditures in 1933 are attributed to the combined effects of larger revenues, higher unit prices, and loans to the railroads from the Public Works Administration.

N. & W. Completes Big Rail Laying Program

The Norfolk & Western recently completed the largest rail-renewal project that it has undertaken during the last 20 years—the laying of 130 track-miles of 131-lb. rail on the Radford and Shenandoah divisions, at a cost of about $2,500,000. The completion of this project, which was commenced on February 4 of this year, brings to a close a rail-laying program started in 1920. With all of the railroad's main-line tracks between Norfolk, Va., and Cincinnati, Ohio, and Columbus having previously been laid with 130 or 131-lb. rail, the N. & W. now has approximately 1,100 miles of this heavy rail.

In laying the 131-lb. rail on the Radford and Shenandoah divisions the railroad used a total of 1,072 carloads of material, including 660 carloads, or 34,300 gross tons, of rail, 180 cars of tie plates, 55 cars of rail joints, 54 cars of track spikes, 43 cars of switches, 12 cars each of track bolts and frogs, 15 cars of guard rails, 18 cars of rail joint plates, 10 cars of rail anchors, 3 cars of rail joint springs and 10 cars of miscellaneous material.

Railroad Loans Increase Employment

The manner in which loans to railroads from the Public Works Administration result in increased employment is shown by the experience of the Southern Pacific. In 1934, employees of this road earned $4,769,000 in wages as the result of a loan of $12,000,000 obtained from the PWA for the purpose of laying 40,000 tons of rail, placing 1,800,000 crossties, rebuilding many bridges, trestles and culverts, and making repairs to more than 5,000 pieces of rolling stock. Work was commenced in February, 1934, when 8,937 maintenance of way and shop employees were called back to their jobs, the peak of employment being reached in May, 1934, when 14,661 men were back on the company's payroll. In addition to the railroad employment created by the loan, employees in industries which supplied materials to the railroad earned more than $6,000,000 in wages as a result of the same loan. The foregoing figures are contained in a report made to Harold L. Ickes, administrator of public works, by the Bureau of Labor Statistics of the Department of Labor.

Railroad Revenues Show Downward Trend

For March the Class I railroads of the United States had net railway operating income of $37,850,965, which was at the annual rate of return of 1.89 per cent on their property investment, as compared with a net of $52,217,083, or 2.60 per cent, in March, 1934. Operating revenues for March totalled $280,898,558, compared with $293,200,602 in the corresponding month of 1934, a decrease of 4.2 per cent. Operating expenses amounted to $213,278,032, as compared with $209,270,377 in March, 1934, an increase of 1.9 per cent.

For the first three months of 1935, the Class I railroads had a net railway operating income of $84,773,560, or 1.69 per cent, as compared with a net of $112,696,133, or 2.24 per cent, in the first quarter of 1934. Operating revenues for the three months amounted to $800,057,121, as compared with $799,672,358 for the same period in 1934, while operating expenses were $626,358,362 as against $593,742,384, an increase of 5.5 per cent. Fifty Class I railroads failed to earn expenses and taxes in the first three months of 1935.

Notes on High-Speed Trains

The trend toward higher passenger train speeds was marked during May by a number of important developments. Notable among these was the completion by the American Car & Foundry Co. of the cars for one of the two new light-weight high-speed trains of the Baltimore & Ohio. This train, which is to be pulled by one of two steam locomotives especially designed and built for high-speed service, is to be placed in high-speed service on the Alton between Chicago and St. Louis on July 1. The new train will make a round-trip daily between these points and will be operated on a regular schedule of 5½ hr. for the 284 miles in each direction. The train, which will consist of eight cars, is built of U.S.S. Cor-Ten steel and weighs 40 per cent less than an equivalent train of conventional steel construction.

Another development in high-speed transport was the announcement that the Union Pacific's high-speed streamlined train, the M-10,001, will be placed in regular service between Chicago and Portland, Ore., on a schedule of 39 hr. 45 min. for the 2,272 miles. The train will operate over the tracks of the Chicago & North Western from Omaha into Chicago and, beginning June 6, will make six round-trips a month.

Beginning June 2 the Twin Zephyrs, high-speed streamlined trains of the Chicago, Burlington & Quincy, will each make a round-trip daily between Chicago and the Twin Cities, instead of the one-way daily trip made previously. Under this arrangement, each train will travel 882 miles a day, as compared with 441 miles a day at present.

Safety Contest Awards

The winning railroads in the eighth annual railroad employees national safety contest were announced by the National Safety Council at a dinner at New York on May 13. For the purpose of this contest the railroads are divided into nine groups according to the number of man-hours worked, the railroad in each group having the lowest casualty rate (killed plus injured per million man-hours) being awarded a bronze plaque. The winning railroads in the various groups, together with the casualty rate, were as follows: Group A (50 million or more man-hours), Chicago & North Western, 2.58; Group B (20 to 50 million man-hours), Atlantic Coast Line, 2.14; Group C (8 to 20 million man-hours), Oregon Short Line, 2.58; Group D (3 to 8 million man-hours), Gulf, Mobile & Northern, 3.29; Group E (1 to 3 million man-hours),

Charleston & Western Carolina, 1.10; Group F (less than 1 million man-hours), Nevada Northern, no casualties. In Group D the lowest casualty rate, 2.70, was attained by the Duluth, Missabe & Northern but owing to a rule of the contest which provides that no contestant is eligible to win a group award for two consecutive years, the award was made to the road having the next best rating.

Two awards were also made to Class I switching and terminal railroads. In Group A of this classification, which includes railroads working 1½ million or more man-hours, the award went to the Indiana Harbor Belt which had a casualty rate of 4.27. A lower rate, 2.13, was attained by the Union (Pittsburgh) which won the award last year and therefore was not eligible this year. In Group B of the switching and terminal railroads, which includes those roads operating less than 1½ million man-hours, the award went to the Conemaugh & Blacklick which had a casualty rate of 1.67.

Recommended Funds for Grade Separation

The use of $200,000,000 of the administrations' work-relief fund for the elimination of railway-highway grade crossings, to be allotted to the states on the basis of population and highway and railroad mileage, has been recommended to President Roosevelt by the Advisory Committee on Allotments. The committee recommended that a total of $400,000,000 be allotted for construction work on highways, roads, streets and grade-crossing eliminations. A list of the states, together with the amount apportioned to each for grade separation, is given below:

Alabama	$ 4,034,617
Arizona	1,256,099
Arkansas	3,574,060
California	7,486,362
Colorado	2,631,567
Connecticut	1,712,684
Delaware	418,239
Florida	2,827,883
Georgia	4,895,949
Idaho	1,674,479
Illinois	10,307,184
Indiana	5,111,096
Iowa	5,600,679
Kansas	5,246,258
Kentucky	3,672,387
Louisiana	3,213,467
Maine	1,426,861
Maryland	2,061,751
Massachusetts	4,210,833
Michigan	6,765,197
Minnesota	5,395,441
Mississippi	3,241,475
Missouri	6,142,153
Montana	2,722,327
Nebraska	3,556,441
Nevada	887,260
New Hampshire	822,484
New Jersey	3,983,826
New Mexico	1,725,286
New York	13,577,189
North Carolina	4,823,958
North Dakota	3,207,473
Ohio	8,439,897
Oklahoma	5,004,711
Oregon	2,334,204
Pennsylvania	11,483,613
Rhode Island	699,691
South Carolina	3,059,956
South Dakota	3,249,086
Tennessee	3,903,979
Texas	10,855,982
Utah	1,230,763
Vermont	729,857
Virginia	3,774,287
Washington	3,095,041
West Virginia	2,677,937
Wisconsin	5,022,683
Wyoming	1,360,841
Dist. of Col.	410,804
Hawaii	453,703
Eng. & Adm. Res.	4,000,000
Total	$200,000,000

Association News

Metropolitan Track Supervisors' Club

The annual meeting of the Metropolitan Track Supervisors' Club will be held at the Hotel McAlpin, New York, on the afternoon and evening of June 6. Aside from the annual dinner and the election of officers, the meeting will be given over largely to entertainment.

International Railway Maintenance Club

The second quarterly meeting of the International Railway Maintenance Club, which was held on May 9, at the Royal Connaught Hotel, Hamilton, Ontario, was addressed by R. B. Steele, transmission engineer of the Canadian National Telegraphs. Mr. Steele, after discussing the scope and ramifications of railway telegraph systems, pointed out features of particular interest to the maintenance of way department, and the different ways in which maintenance of way employees can co-operate to the end of insuring the most reliable telegraph service. About 40 members and guests were in attendance at the meeting. The next meeting of the club is set, tentatively, for August 8, at the Royal Connaught Hotel, at Hamilton.

American Railway Engineering Association

The board of direction is contemplating a meeting in Detroit, Mich., during the week of June 24, coincident with the convention of the American Society for Testing Materials.

The annual booklet containing the final appointments to the various committees is in the hands of the printer and will go to the members early in June.

Four committees held meetings during the month, including Water Service and Sanitation at Cincinnati, Ohio, on May 7-8; Masonry, at Chicago on May 8-9; Iron and Steel Structures at Chicago on May 9-10; and Records and Accounts at Cleveland, Ohio, on May 23.

Among the committees which have called meetings for June are those on Wooden Bridges and Trestles, at Chicago on June 20, and Ballast, at Chicago on June 22. The Track committee will meet in Chicago and St. Paul, Minn., on June 12 and 13, including in its meeting an inspection of the manner in which the tracks of the North Western, the Burlington and the Milwaukee have been prepared for high speed service.

"Laminex Plyform"—A 10-page illustrated pamphlet issued recently by the Wheeler-Osgood Sales Corporation, Tacoma, Wash., is devoted to a discussion of "Laminex Plyform," a specially-treated plywood designed especially for use in concrete form construction. In addition to describing this product, the booklet gives complete instructions and specifications concerning its use.

Personal Mention

General

S. H. Osborne, division engineer on the Union Pacific at Denver, Colo., who has been appointed assistant to the executive vice-president, as noted in the May issue, has been connected with the Union Pacific System since 1900, except for a two-year period when he was engaged in other work. His first service was with the Oregon Short Line (a unit of the U.P.

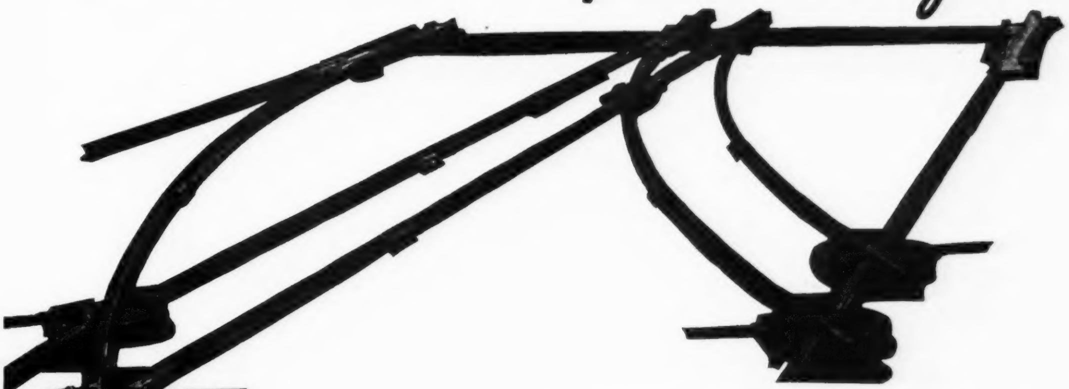
S. H. Osborne

Sys.) where he was advanced through various positions in the engineering department to that of assistant engineer in charge of branch-line construction in 1909. He held this position until 1913, when he was further promoted to division engineer of the Idaho division. In December, 1914, he left railway work, but re-entered the service of the Union Pacific in February, 1917, as an assistant engineer in the office of the engineer maintenance of way at Omaha. In December of the same year he was appointed division engineer of the Kansas division, then serving successively in the same capacity on the Nebraska, Los Angeles, and Colorado divisions. On February 15, 1927, Mr. Osborne was appointed engineer maintenance of way at Omaha and, when this office was discontinued in 1931, he returned to the Colorado division as division engineer. He was holding this position at the time of his recent appointment as assistant to the executive vice-president, in which capacity he will have supervision over safety matters.

Engineering

T. J. Jayne, assistant engineer of grade crossings on the New York Central, Buffalo and East, with headquarters at New York, has been appointed acting engineer of grade crossings, with the same headquarters, succeeding **J. G. Brennan,** who has been appointed secretary of a special committee of the Association of American Railroads, which will represent the carriers in connection with the allo-

Standard Railroad Tracks within crane tracks *in unusual special layout*




AN INTERESTING piece of special trackwork was recently completed in the Bethlehem shops at Steelton, Pa. The layout, a section of which is shown here, consists of crane tracks and standard railroad tracks arranged in a gauntlet manner, the railroad tracks within the gage of the crane tracks.

The layout contains various materials, all manufactured by Bethlehem Steel Company, and consisting of 20 sets of specially designed railroad tongue switches, mates and frogs; 6 specially designed crane-track switches; 25 circular or turntable frogs; 20 expansion joints; 30 car stops; and 30,000 feet of straight and special curved rails with all necessary fittings, including angle-bar joints, braces, clips and spikes.

Switch pieces were all specially designed. Crane-rail switches have heavy cast-steel bodies with heavy renewable manganese-steel tongue- and end-pieces.

The railroad switches have heavy cast-steel bodies with renewable manganese-steel insert wearing-plates and tongues. Switches are equipped with a spring ground throw inclosed in a cast-iron box.

The railroad mates and frogs have heavy cast-steel bodies, with renewable manganese-steel wearing plates.

The crane-track frogs have cast-steel bodies with circular manganese-steel inserts. These inserts required very precise grinding to insure a good fit on the bottom and side wearing surfaces.

This layout is an example of Bethlehem's ability to meet unusual trackwork requirements. Whatever you may require in special trackwork, Bethlehem is prepared to design and build it quickly, accurately and economically.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

GENERAL OFFICES: BETHLEHEM, PA.

cation of grade crossing elimination funds from the Administration's $4,000,000,000 work-relief fund. Mr. Brennan has also been appointed to the staff of the vice-president in charge of operation and maintenance of the A.A.R. as engineer of grade crossings.

A. E. Perlman, formerly a roadmaster on the Northern Pacific and more recently connected with the Reconstruction Finance Corporation, has been appointed to the newly-created position of assistant engineer maintenance of way of the Chicago, Burlington & Quincy, with headquarters at Chicago.

H. H. Pevler, supervisor of track on the Pennsylvania, with headquarters at Washington, D. C., has been promoted to division engineer of the St. Louis division, with headquarters at Terre Haute, Ind., succeeding **R. H. Crew,** who has been transferred to the Ft. Wayne division, with headquarters at Ft. Wayne, Ind. Mr. Crew succeeds **P. E. Feucht,** whose promotion to superintendent of the Wilkes-Barre division with headquarters at Sunbury, Pa., was noted in the May issue.

Charles W. Pitts, an assistant engineer on the Union Pacific, who has been promoted to division engineer at Denver, Colo., as noted in the May issue, was born on March 9, 1888, at Hull, England, and received his engineering education in that country. He first entered railway service on June 2, 1910, with the Oregon Short Line (a unit of the Union Pacific System), serving in various engineering capacities, including those of instrumentman and assistant engineer on construction, valuation and maintenance until August 3, 1922. On that date Mr. Pitts was transferred to the Union Pacific unit of the system where he served as a draftsman, assistant engineer on maintenance of way work, roadmaster and division engineer until 1928 when he was appointed division engineer of the Central division. Since February, 1931, when the position of division engineer of the Central division was abolished, Mr. Pitts has served as roadmaster and assistant engineer on maintenance of way work and various engineering projects. His appointment as division engineer on the Colorado division, with headquarters at Denver, was effective on April 16.

Track

W. G. Robertson, a track foreman on the Michigan Central, with headquarters at Fletcher, Ont., has been promoted to roadmaster, with headquarters at St. Thomas, Ont., to succeed **G. L. Glover,** who has been transferred to Windsor, Ont. Mr. Glover succeeds **C. Hawkins,** who retired on April 30 and whose death is noted elsewhere in these columns.

D. DeGroat, extra gang foreman on the River division of the New York Central, has been promoted to assistant track supervisor on Subdivision 34 of the River division, with headquarters at Kingston, N. Y., where he succeeds **Elmer Smith,** who has been transferred to subdivision 10 of the Syracuse division, with headquarters at Lyons, N. Y. Mr. Smith relieves **H. V. Smith,** who has been transferred to Subdivision 2 of the Electric division, with headquarters at Spuyten Duyvil, N. Y.

F. L. Williams has been appointed supervisor of track on the St. Louis district of the Illinois division of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Hillsboro, Ill., succeeding **J. G. Hendricks,** whose death is noted elsewhere in these columns.

William C. Whitworth, supervisor of track on the Birmingham division of the Louisville & Nashville, with headquarters at Iron City, Tenn., retired from active service on May 1, at the age of 72 years. Mr. Whitworth had been in the service of the L. & N. continuously for nearly 47 years.

H. C. Kirkpatrick, a rodman in the engineering department of the Canadian National, with headquarters at Winnipeg, Man., has been appointed acting roadmaster on the Portage-Brandon division, with headquarters at Fort Rouge (Winnipeg), succeeding **F. J. Ellis,** who has retired after 22 years of service with this company. **W. J. Marchen** has resumed his duties as roadmaster on the Dauphin, division, with headuarters at Dauphin, Man., after a leave of absence for several months because of ill health. **F. Roy,** who has been acting as roadmaster at Dauphin during Mr. Marchen's absence, has resumed the duties of transitman.

Obituary

C. Hawkins, roadmaster on the Canada division of the Michigan Central, with headquarters at Windsor, Ont., who retired on April 30 after 52 years of service with this company, died on May 12.

Adelphus C. Terrell, valuation engineer of the Northern Pacific, with headquarters at St. Paul, Minn., died on May 10, following a three months illness. Mr. Terrell had been connected with the Northern Pacific for 29 years. Before going with the Northern Pacific he had served with other roads about six years.

J. G. Hendricks, supervisor of track of the St. Louis district of the Illinois division of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Hillsboro, Ill., died on March 29. Mr. Hendricks had been in the service of the Big Four continuously for 50 years.

Charles F. Loweth, who retired on May 1 as chief engineer of the Chicago, Milwaukee, St. Paul & Pacific, died on May 15 at the Chicago Memorial hospital at the age of 78 years. He had been in ill health for about six months and had recently undergone an operation. A photograph and biographical sketch of Mr. Loweth were published in the May issue of *Railway Engineering and Maintenance* on the occasion of his retirement as chief engineer and his appointment as consulting engineer.

John V. Hanna, chief engineer of the Kansas City Terminal, Kansas City, Mo., who died suddenly on April 30, as noted in the May issue, was born in 1864 at Plattsmouth, Neb., and was educated at the Sheffield Scientific School, Yale university. His first railway service was with the Chicago, Burlington & Northern (now part of the Chicago, Burlington & Quincy) in 1885. In the following year he went with the Colorado Railway (now part of the Colorado & Southern) as assistant engineer, being appointed resident engineer of the Current River Railroad (now part of the St. Louis-San Francisco) in 1887. For a short time during 1888, Mr. Hanna served as assistant engineer

John V. Hanna

on the Kansas City, Fort Scott & Memphis (now part of the Frisco) and in 1889 he engaged in mining activities in Colorado. In January, 1891, after serving for a time as a shop inspector in connection with the construction of the Thames River bridge, Mr. Hanna was appointed assistant engineer on the Kansas City, Memphis & Birmingham (now also part of the Frisco). Eight years later he was appointed a resident engineer on the K.C.F.S. & M., being advanced to assistant chief engineer of this road in 1900. In the following year Mr. Hanna was made assistant chief engineer of the Frisco and in 1904 he was made principal assistant engineer, later serving as assistant engineer maintenance of way. In August, 1906, he was appointed chief engineer of the Kansas City Terminal, in which capacity he was in complete charge of the extensive terminal improvement project that included the construction of the present Union Station at Kansas City, Mo. He held the position of chief engineer of the Kansas City Terminal continuously until his death.

Edward L. Koch, assistant to division engineer on the Pennsylvania, with headquarters at Baltimore, Md., died at his home in Ruxton, Md., on April 29. Mr. Koch was born on August 17, 1883, at Huntington, Pa. He started work with the state highway department of Pennsylvania, but soon thereafter, on September 9, 1902, he entered the service of the Pennsylvania railroad as a chainman in the construction department. In November, 1904, while still continuing his education in night school, he became a chainman in the maintenance of way department, with headquarters at Altoona, and on July 1, 1905, he was promoted to rodman, with the same headquarters. Later

he was transferred to the Middle division, and on November 22, 1909 he was promoted to transitman, with headquarters at the general offices, at Philadelphia, Pa. On April 1, 1910, he was appointed assistant supervisor on the Cresson division, and subsequently held the same position on the Conemaugh and Pittsburgh divisions. On February 5, 1917, he was promoted to supervisor on the Maryland division, and on December 1 of the same year was transferred to the West Jersey & Seashore railroad, where he remained until March 1, 1920, when he again became a supervisor on the Maryland division. On August 1, 1929, he was promoted to assistant to division engineer on the Maryland division, with headquarters at Baltimore. In recent years, in this capacity, he was actively engaged in the extensive auxiliary maintenance of way work attendant upon the major improvements of the road, including electrification, through Baltimore. Mr. Koch attained an enviable record while track supervisor, having won the Eastern region improvement prize for two successive years, and, while on the Maryland division, the Southern grand division prize for excellence in track maintenance, for a number of years.

Harry A. Roberts, division engineer on the Oregon-Washington Railroad & Navigation Company (a unit of the Union Pacific System), with headquarters at Portland, Ore., who died suddenly on April 6, as noted in the May issue, was born on April 2, 1876, at Strawn, Ill. Mr. Roberts obtained his engineering education at the University of Illinois, and first entered railway service with the Chicago & Alton (now the Alton) in 1899 as a rodman, going with the Atchison, Topeka & Santa Fe in the same capacity in the following year. For a time in 1901, Mr. Roberts served with the United States Interior department as a transitman, then returning to the Santa Fe to serve as an assistant engineer and resident engineer until 1903. In that year he went with the Delaware, Lackawanna & Western as a bridge designer and in July, 1904, he entered the service of the Oregon Short Line (also a unit in the Union Pacific System) as an assistant engineer. Two years later Mr. Roberts was promoted to division engineer and in December, 1909, he was made assistant superintendent, returning to the position of division engineer in 1913. In the following year he accepted an assistant professorship in civil engineering at the University of Kansas, holding this position until the outbreak of the World War, when he joined the engineering corps of the United States army. Following the war Mr. Roberts resumed his former position at the University of Kansas, where he remained until July, 1919, when he again entered the service of the Oregon Short Line as division engineer. On April 1, 1920, he was appointed engineer maintenance of way of the O-W. R.R. & N. with headquarters at Portland, and on September 1, 1931, following the discontinuance of this position, he was appointed division engineer of the Oregon division, which position he continued to hold until his death.

Supply Trade News

General

The Harnischfeger Corporation, Milwaukee, Wis., and the **Caterpillar Tractor Company,** Peoria, Ill., have entered into a co-operative arrangement for the building of Diesel-powered generator sets, ranging in capacities from 35 to 60 kw.

The Philadelphia, Pa., district sales office of the **Republic Steel Corporation,** and subsidiaries, the **Berger Manufacturing Company** and the **Union Drawn Steel Company,** were moved on May 18, from the Fidelity-Philadelphia Trust building to the Broad Street Station building, 1617 Pennsylvania boulevard. **J. B. DeWolf** continues in charge of the office as district manager, assisted by the present staff.

Merger of the **Republic Steel Corporation** and the **Corrigan McKinney Steel Company** was given the approval of the federal district court at Cleveland, Ohio, on May 3, when Judge Frederick M. Raymond ruled against the government in its suit to block the amalgamation. In the court's opinion, the merger would not be in violation of the Clayton anti-trust act as charged by government attorneys. Likewise the government had failed to furnish sufficient proof that the merger would cause any substantial lessening of competition or would result in any probable injury to the public.

Personal

D. R. Manuel has been appointed western manager of the **Curtin-Howe Corporation, New York,** with headquarters at Chicago and will have jurisdiction over the Minneapolis territory, the Pacific Northwest and Chicago and vicinity.

Harry F. Boe, who has been manager of the Buffalo office of the Westinghouse Electric & Manufacturing Company since 1926, has been appointed assistant manager of the Eastern district, with headquarters at New York.

A. M. Candy, chief welding engineer of the Westinghouse Electric & Manufacturing Co., has been appointed consulting engineer on the staff of the **Hollup Corporation,** Chicago. Mr. Candy will be engaged in the development of welding machines and improved welding practices, with particular reference to the application of the welding process to railroad requirements.

J. E. Holveck has been appointed special sales engineer of the **Worthington Pump & Machinery Corporation,** Harrison, N. J., operating from its Pittsburgh, Pa., office, but extending his activities also to the territories of the Cleveland, Ohio, Detroit, Mich., Chicago and Buffalo, N. Y., offices. Mr. Holveck was formerly a member of the engineering staff of Worthington's Holyoke works and later was associated with The Aldrich Pump Company as sales engineer in its Pittsburgh and middle west districts. He has been responsible for many developments in pumping equipment and hydraulic accessories.

Dr. John Chipman has joined the research staff of **The American Rolling Mill Company,** Middletown, Ohio, as associate director of the research laboratories. He will be responsible for research activities in the field of melting and refining metals. For six years he was research engineer in the Department of Engineering Research at the University of Michigan.

Edward M. Adams, first vice-president in charge of sales and a director of the Inland Steel Company, Chicago, died on May 8 at Hot Springs, Ark., following a heart attack which occurred on April 24.

James D. Archibald, superintendent of field service for the Syntron Company, Pittsburgh, Pa., died on April 18, following a three months' illness. Prior to becoming connected with the Syntron Company seven years ago, Mr. Archibald had served in the maintenance of way department of the Pennsylvania for 26 years, during many years of which he served as supervisor of track at various points.

Everit Terhune, president, Associated Business Papers, Inc., (left) presenting to Roy S. Durstine, vice-president of Batten, Barton, Durstine & Osborn, advertising agency (right) the first certificate of agency recognition ever awarded by the A.B.P. to an advertising agency. John Benson, president of the American Association of Advertising Agencies (center) is looking on. In accepting this certificate, Mr. Durstine stated that practically every account whose advertising is handled by his agency believes in and uses business paper space as an essential part of its advertising program. It is because of this policy that Batten, Barton, Durstine & Osborn placed more pages of advertising with member publications of the A.B.P., Inc., than any other agency in the land during each of the last four years.

Approximately 250 other advertising agencies now meeting requirements of the A.B.P. for recognition are to receive similar recognition certificates in the near future.

NEW CONDITIONS

Create *NEW* MARKETS

The Zephyr, the "400", the Flying Yankee, the Hiawatha, the Comet, the Abraham Lincoln, the Streamliner City of Portland, etc., are indicative of the railways' answer to the demands for faster service.

Faster schedules require better track—more refined maintenance—and with minimum increase in cost. These exacting requirements require better materials—more mechanical equipment.

These trains are creating markets—new markets for some manufacturers, enlarged markets for others.

These markets are reached by Railway Engineering and Maintenance.

Its readers include those railway officers who maintain the tracks and structures for these trains and who select and specify the materials and equipment required therefor.

Maintenance Mike says—"The boss says that these fast trains will run us ragged if we don't get better track materials and also more power equipment."

RAILWAY ENGINEERING AND MAINTENANCE IS READ BY MAINTENANCE OFFICERS OF ALL RANKS

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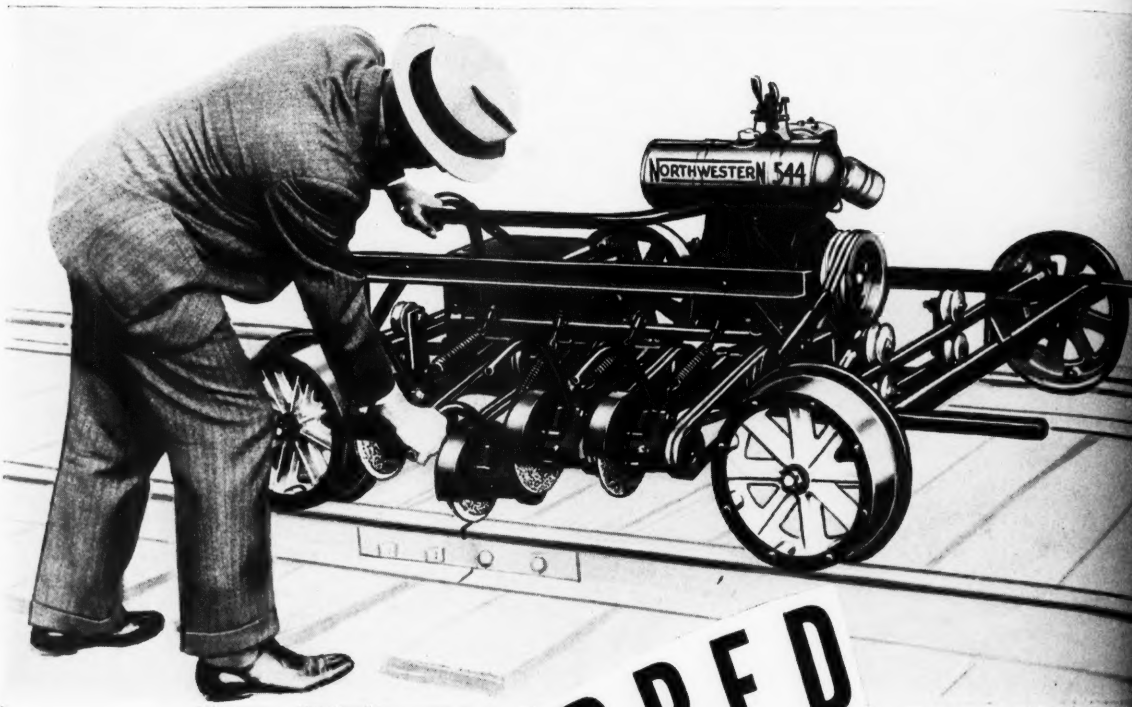
Northwestern's Latest



TIMKEN-EQUIPPED

Northwestern's latest contribution to the cause of efficient and economical track maintenance is a splendid example of the effective and thorough use of Timken Tapered Roller Bearings in promoting speedy, dependable and low cost operation. The Northwestern 544 Selective Rail Joint Slotter and Beveler contains 18 Timken Bearings — 2 in each axle housing, 2 in each of the 4 grinding wheel arbors and 2 on the grinding wheel countershaft. This means that all of these vital parts are completely protected against friction; wear; radial, thrust and combined loads; and misalignment. It is an indication of the endurance and long life that have come to be associated with the exclusive combination of Timken tapered construction, Timken positively aligned rolls and Timken Alloy Steel in all types of equipment throughout all industry.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN TAPERED ROLLER BEARINGS